DOE/EA-1464

Environmental Assessment for Proposed Corrective Measures at Material Disposal Area H within Technical Area 54 at Los Alamos National Laboratory, Los Alamos, New Mexico

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Department of Energy
National Nuclear Security Administration
Los Alamos Site Office

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Acronyms and Terms

°C	degrees Centigrade
°F	degrees Fahrenheit
ac	acres
ALARA	as-low-as-reasonably-achievable
ASR	Alkali-Silica Reaction
BMPs	best management practices
CAA	*Clean Air Act*
CFR	Code of Federal Regulations
cm	centimeter
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
dB	decibels
dBA	A-weighted frequency scale
DOE	(U.S.) Department of Energy
DOT	(U.S.) Department of Transportation
DSA	documented safety analysis
DU	depleted uranium
EA	environmental assessment
EM	Environmental Management
EPA	(U.S.) Environmental Protection Agency
ET	evapotranspiration
ft	feet
ft^2	square feet
FY	fiscal year
ha	hectares
HAPs	hazardous air pollutants
HE	high explosives
HEPA	high-efficiency particulate air (filter)
HSWA	Hazardous and Solid Waste Amendments
in.	inch
JMVF	Jemez Mountains volcanic field
kg	kilograms
km	kilometers
km^2	square kilometers
kph	kilometers per hour
LANL	Los Alamos National Laboratory
lb	pounds
LLW	low-level waste
m	meters
m^2	square meters
m^3	cubic meters
MDA	Material Disposal Area
MEI	maximally exposed individual
mi	miles
mi^2	square miles
mm	millimeters
mph	miles per hour
mrem	millirems
NAAQS	National Ambient Air Quality Standards
NEPA	*National Environmental Policy Act of 1969*
NESHAP	National Emission Standards for Hazardous Air Pollutants
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NTS	Nevada Test Site
OSHA	Occupational Safety and Health Administration
PM	particulate matter
PPE	personal protective equipment
PRSs	potential release sites
RCRA	*Resource Conservation and Recovery Act*
RFI	RCRA facility investigation
ROD	Record of Decision
SIP	State Implementation Plan
SR	State Road

SWEIS	Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory
SWMUs	solid waste management units
TA	Technical Area
TLV	threshold limit value
TRU	transuranic
TSD	treatment, storage, and disposal
UC	University of California
U.S.	United States
USC	United States Code
VOCs	volatile organic compounds
WIPP	Waste Isolation Pilot Plant
WM PEIS	Waste Management Programmatic Environmental Impact Statement
yd^3	cubic yards

EXPONENTIAL NOTATION: Many values in the text and tables of this document are expressed in exponential notation. An exponent is the power to which the expression, or number, is raised. This form of notation is used to conserve space and to focus attention on comparisons of the order of magnitude of the numbers (see examples):

1×10^{4}	=	10,000
1×10^{2}	=	100
1×10^{0}	=	1
1×10^{-2}	=	0.01
1×10^{-4}	=	0.0001

Metric Conversions Used in this Document

Multiply	By	To Obtain
Length		
inch (in.)	2.54	centimeters (cm)
feet (ft)	0.30	meters (m)
yards (yd)	0.91	meters (m)
miles (mi)	1.61	kilometers (km)
Area		
acres (ac)	0.40	hectares (ha)
square feet (ft^2)	0.09	square meters (m^2)
square yards (yd^2)	0.84	square meters (m^2)
square miles (mi^2)	2.59	square kilometers (km^2)
Volume		
gallons (gal.)	3.79	liters (L)
cubic feet (ft^3)	0.03	cubic meters (m^3)
cubic yards (yd^3)	0.76	cubic meters (m^3)
Weight		
ounces (oz)	28.35	grams (g)
pounds (lb)	0.45	kilograms (kg)
short ton (ton)	0.91	metric ton (t)

Executive Summary

Material Disposal Area (MDA) H is located within Technical Area 54 at Los Alamos National Laboratory (LANL) in northern New Mexico. The fenced site is about 70 feet (ft) (21 meters [m]) by 200 ft (60 m), (0.3 acres [ac] [0.12 hectares (ha)]) in size, and consists of nine inactive vertical in-ground shafts. Between 1960 and 1986, the site was used for the burial of classified containerized and non-containerized solid-form wastes, some of which were residually contaminated with radioactive, hazardous, and high-explosives constituents. The major waste placed in the subsurface shafts at MDA H was radioactive metal, of which most is either indicated to be depleted uranium (DU) or postulated to be DU.

The New Mexico Environment Department (NMED) identified the need to perform a Corrective Measure Study (CMS) at MDA H. A CMS Report prepared for MDA H evaluated various corrective measure options for MDA H. The United States Department of Energy (DOE), National Nuclear Security Administration (NNSA) now needs to implement a corrective measure for MDA H, so as to comply with the legal requirements of the *Resource Conservation and Recovery Act* (RCRA) and the *Atomic Energy Act of 1954*. The need for implementation of a corrective measure at MDA H is based on future potential for releases that might create unacceptable risks or doses to human health or the environment.

This environmental assessment (EA) has been prepared to assess the potential environmental consequences of implementing a corrective measure at MDA H. The Proposed Action has five corrective measure options. There are three containment corrective measure options, discussed in Section 2.4.1, and two excavation and removal corrective measure options, discussed in Section 2.4.2. The corrective measure option preferred by DOE is corrective measure Option 2, Replacement of the Existing Surface with an Engineered Evapotranspiration Cover. This corrective measure option was recommended for implementation to the State of New Mexico in the CMS Report.

The corrective measure options analyzed in this EA address a range of potential containment and excavation options and are intended to provide a bounding analysis of the potential environmental effects of implementing any corrective measure at MDA H. The final selection of a corrective measure option would be made by the NMED, which has been delegated RCRA corrective action authority from the Environmental Protection Agency. NMED is not obligated to select any one of the five corrective measure options analyzed in this EA. NMED could choose a combination of corrective measures or a totally different corrective measure option.

The No Action Alternative was also considered. Under this alternative, none of the corrective measure Options 1 through 5 described in Sections 2.4.1 through 2.4.2.2, would be undertaken at this site. A Long-Term Environmental Stewardship Program would be implemented at the site for the No Action Alternative, as well as for all the other containment corrective measure options considered.

Work at MDA H for any of the five corrective measure options could require the use of heavy equipment such as drill rigs, cranes, cement trucks, dump trucks, trackhoes, excavators, front-end loaders, and backhoes. Proposed corrective measure options involving waste excavation could also require the use of remote-handling equipment. A detailed engineering study, complete hazard categorization and safety analysis would be required for implementing the excavation and

removal corrective measure options. Appropriate nuclear safety analyses, authorization basis, security measures, and a site-specific security plan would also be developed, approved by DOE, NNSA, and implemented before site work commenced. New support structures and site area modifications could be required to implement either of the two proposed excavation and removal corrective measure options. Implementation of these corrective measure options would involve specific waste management requirements that would be incorporated into procedures documented in the security plan and implemented at the site. All excavation and declassification activities would be conducted consistent with this security plan. During site activities, space in the immediate vicinity would be available for vehicle parking, equipment storage, and material staging. Existing site controls (such as fencing) would limit unauthorized public access.

Best management practices (BMPs) for soil erosion control purposes would be implemented, as necessary, for any site remediation activities involving soil disturbance. BMPs could include runon and runoff controls, such as straw bales, silt fencing, ditching, and similar storm water flow controls. Special air pollution control technologies would be applied as necessary and appropriate. A National Pollutant Discharge Elimination System General Permit Notice of Intent would be filed, if required, based on the corrective measure option chosen for implementation. A Storm Water Pollution Prevention Plan would be required for the construction activity.

Implementation of the Proposed Action would not adversely affect groundwater and surface water quality, air quality in the Los Alamos airshed, human health, environmental justice, or socioeconomics. Implementation of either of the excavation and removal options would be expected to have only minor short-term and temporary effects on current traffic patterns and visual resources. Waste types and quantities generated by the excavation and removal of wastes from the MDA H shafts would be within the capacity of existing waste management systems and would not be likely to result in substantial effects to existing waste management disposal operations. When added to the much larger volume of environmental restoration waste at LANL, the Proposed Action would not contribute to significant adverse cumulative effects.

Implementation of a corrective measure option at MDA H would provide long-term beneficial impacts through the reduction of potential risks from contamination. Currently, LANL programs operate within regulatory requirements. The Proposed Action is an extension of LANL operations. DOE and LANL are pursuing an active program of reducing potential health risk through an as-low-as-reasonably-achievable (ALARA) policy for all personnel and the public. Implementation of a corrective measure option at MDA H would minimize any future potential releases that might create unacceptable risks or doses to the public or the environment.

1.0 Purpose and Need

Chapter 1 presents the United States (U.S.) Department of Energy (DOE), National Nuclear Security Administration's (NNSA) [1] requirements under the *National Environmental Policy Act of 1969* (NEPA), background information on the proposal, the purpose and need for agency action, and a summary of public involvement activities.

1.1 Introduction

NEPA requires Federal agency officials to consider the environmental consequences of their proposed actions before decisions are made. In complying with NEPA, DOE and NNSA follow the Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] 1500-1508 (40 CFR 1500-1508)) and DOE's NEPA implementing procedures (10 CFR 1021). The purpose of an environmental assessment (EA) is to provide Federal decision makers with sufficient evidence and analysis to determine whether to prepare an environmental impact statement or issue a Finding of No Significant Impact.

At this time, the NNSA is considering the implementation of a corrective measure at Material Disposal Area (MDA) H within Technical Area (TA) 54 at Los Alamos National Laboratory (LANL). LANL is a Federal facility located at Los Alamos, New Mexico (Figure 1), that comprises about 40 square miles (mi^2) (103.6 square kilometers [km^2]) of buildings, structures, and forested land. The facility is administered by NNSA for the Federal government, and managed and operated under contract by the University of California (UC). This EA has been prepared to assess the potential environmental consequences of implementing a corrective measure at MDA H and a No Action Alternative.

The objectives of this EA are to (1) describe the underlying purpose and need for DOE, NNSA action; (2) describe the Proposed Action and identify and describe any reasonable alternatives that satisfy the purpose and need for Agency Action; (3) describe baseline environmental conditions at LANL's TA-54; (4) analyze the potential indirect, direct, and cumulative effects to the existing environment from implementation of the Proposed Action, and (5) compare the effects of the Proposed Action with the No Action Alternative and other reasonable alternatives.

For the purposes of compliance with NEPA, reasonable alternatives are identified as being those that meet NNSA's purpose and need for action by virtue of timeliness, appropriate technology, and applicability to LANL. The EA process provides NNSA with environmental information that can be used in developing mitigative actions, if necessary, to minimize or avoid potential adverse effects to the quality of the human environment and natural ecosystems should NNSA decide to proceed with the Proposed Action of implementing a corrective measure at MDA H. Ultimately, the goal of NEPA, and this EA, is to aid NNSA officials in making decisions based on an understanding of environmental consequences and in taking actions that protect, restore, and enhance the environment.

[1] The NNSA is a separately organized agency within the DOE established by the 1999 *National Nuclear Security Administration Act* (Title 32 of the *Defense Authorization Act* for fiscal year (FY) 2000 [Public Law 106-65]).

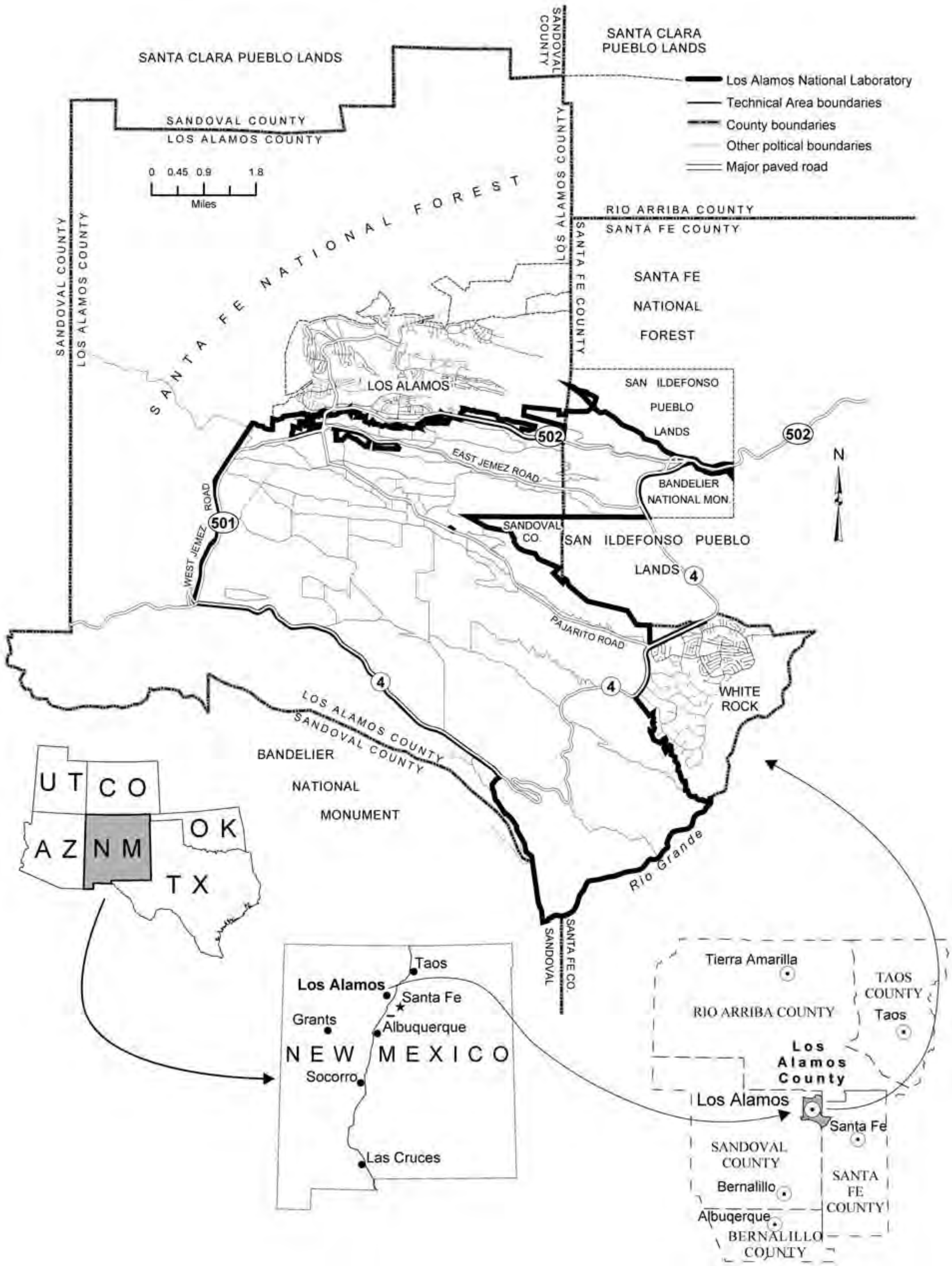

Figure 1. Location of Los Alamos National Laboratory.

1.2 Background

LANL is located in north-central New Mexico within a region characterized by forested areas with mountains, canyons, and valleys, as well as diverse cultures and ecosystems. The Federal government agency with administrative responsibility for LANL has evolved from the post-World War II Atomic Energy Commission, to the Energy Research and Development Administration, and finally to the DOE, NNSA. UC is the current LANL Management and Operating Contractor and has served in this capacity since the facility's inception in 1943.

TA-54 is located in the east-central portion of LANL (Figure 2) on Mesita del Buey between Pajarito Canyon (south) and Cañada del Buey (north). During the late 1950s, this technical area was chosen to serve as a consolidated radioactive and chemical waste treatment, storage, and disposal (TSD) site for LANL. Wastes generated at various other LANL technical areas were to be managed at this single waste management site, rather than managed at various sites scattered over LANL near their generation locations as was the prior practice. Current storage activities at TA-54 for *Resource Conservation and Recovery Act*- (RCRA-) regulated hazardous and mixed wastes are conducted under the administrative authority of DOE, the U.S. Environmental Protection Agency (EPA), and the New Mexico Environment Department (NMED).

There are four designated areas at TA-54 used for the TSD of solid[2], sensitive (classified[3]), hazardous[4], radioactive, or mixed[5] waste generated at LANL. Two of these areas are active and contain a number of solid waste management units (SWMUs); these two areas are known as Areas G and L. The other two areas are inactive and are known as MDAs H and J. Classified solid-form wastes were disposed of at MDA H from May 1960 through August 1986. MDA J was used from 1961 until 2001 to dispose of industrial solid waste. Area L was used for the disposal of liquid chemical wastes from 1964 until 1985 and is now used to receive, store, and ship toxic, hazardous, and mixed radioactive wastes to permitted offsite disposal facilities; and Area G, which has been in use since 1957, is used principally for the disposal of solid low-level radioactive waste (LLW)[6] and for the storage of TRU[7] wastes.

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[2] Solid waste, as defined in 40 CFR 261.2 and in 20 New Mexico Administrative Code (NMAC) 9.1, is any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.

[3] Classified waste includes all types of classified items such as classified documents, parts, shapes, molds, computers, or computer media that could provide information that must be protected in the interest of national security, as authorized under Executive Order 12958 or any superseding order; Restricted Data classified under the *Atomic Energy Act of 1954*, as amended; or Formerly Restricted Data.

[4] Hazardous waste, as defined in 40 CFR 261.3, which addresses RCRA regulations, and by reference in 20 NMAC 4.1, is waste that meets any of the following criteria: a) waste exhibits *any* of the four characteristics of a hazardous waste: ignitability, corrosivity, reactivity, or toxicity; b) waste is specifically *listed* as being hazardous in one of the four tables in Subpart D of the CFR; c) waste is a mixture of a *listed* hazardous waste item and a nonhazardous waste; d) waste has been *declared* to be hazardous by the generator.

[5] Mixed waste is defined as any waste containing both hazardous and source, special nuclear, or by-product materials subject to the *Atomic Energy Act of 1954*.

[6] LLW is radioactive waste that is not high-level waste, spent nuclear fuel, transuranic (TRU) waste, by-product material (as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*, as amended), or naturally occurring radioactive material (DOE 2001).

[7] TRU waste is radioactive waste containing more than 100 nanocuries (3,700 becquerels) of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years, except for (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or (3) waste that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61 (DOE 2001).

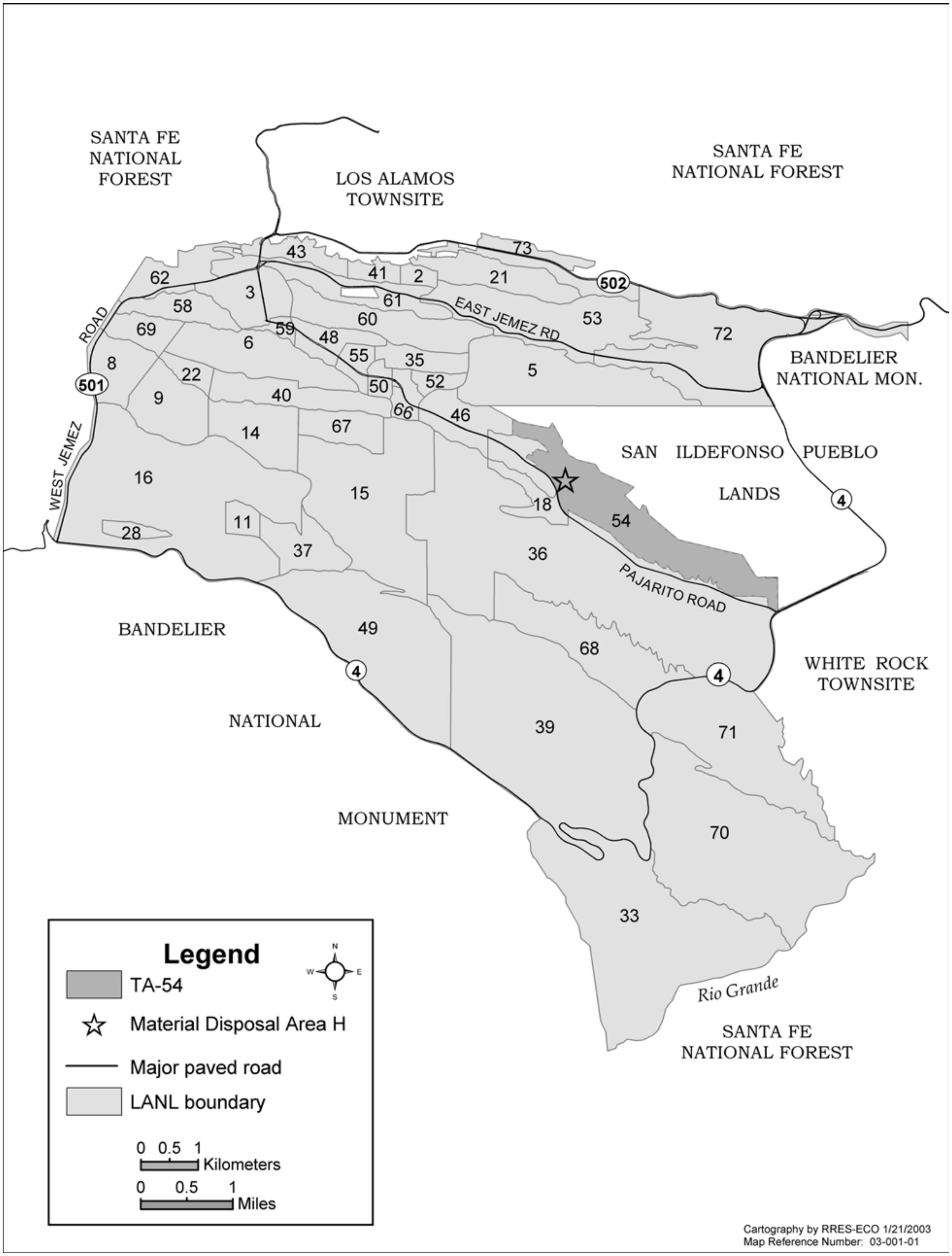

Figure 2. Location of MDA H within TA-54.

MDA H is a relatively small, fenced site about 70 feet (ft) (21 meters [m]) by 200 ft (60 m), (0.3 acres [ac] [0.12 hectares (ha)]) in size, consisting of nine inactive vertical in-ground shafts arranged in a row (Figure 3). Between 1960 and 1986, the site was used for the burial of classified solid-form wastes, and containerized and non-containerized solid-form wastes, some of which were residually contaminated with radioactive, hazardous, and high-explosives (HE) constituents.

Disposals at MDA H were recorded in a logbook, which contained a brief description of the waste and an approximate weight. These descriptions include sufficient information to identify, with some degree of certainty, the types of hazardous waste and radionuclides placed in the shafts. However, the exact amount of waste has not been absolutely quantified. A major component of waste placed in the subsurface shafts at MDA H was radioactive metal, of which half was either indicated in the logbook to be depleted uranium (DU) or postulated to be DU. A small percentage of the waste at MDA H was recording media (such as paper documents, film, slides, and magnetic computer tapes). Graphite is also present in the waste inventory. The RCRA-regulated hazardous waste component of the MDA H inventory includes lithium hydride (a reactive compound) and HE. In addition, phthalate-containing plastics are present, as is tritium. Details of the MDA H disposal inventory can be found in the MDA H Corrective Measures Study (CMS) Report, Appendix B (LANL 2003), discussed later in the text of this EA.

Because of the inventory of radioactive material contained in MDA H, it is regulated as a nuclear facility under DOE's nuclear safety management regulations (10 CFR 830). The current regulatory basis for analyzing and addressing the management of radioactive wastes at LANL is contained in DOE Orders 435.1, "Radioactive Waste Management," (DOE 2001) and 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1993a). These DOE orders, together with RCRA, the *New Mexico Hazardous Waste Act* and the New Mexico Solid Waste Management Regulations (all three of which govern the disposal of hazardous wastes), regulate both the short-term and long-term management (including disposal by in-ground burial) of radioactive and hazardous wastes at LANL. These laws, regulations, and DOE orders were not in effect at the time TA-54 started to receive wastes; before the 1960s, the *Atomic Energy Act of 1954* (42 United States Code [USC] 2001) contained the only provisions applicable to radioactive or hazardous waste management and disposal at LANL. No regulatory requirements were in effect during the 1960s that required new waste disposal sites to be either lined or monitored, as are currently required by the laws and regulations governing new buried waste disposal sites today.

The regulatory basis for analyzing and addressing the management of hazardous waste is RCRA. Pursuant to the RCRA corrective action requirements, a RCRA facility assessment (an initial site assessment) of MDA H and other potential release sites (PRSs) at LANL was completed in 1990 (LANL 1990a); a RCRA facility investigation (RFI) (LANL 2001a) and addendum for MDA H (LANL 2002a) was completed in 2002. NMED approved the RFI report and addendum on April 11, 2003.

Section VIII.L of LANL's Hazardous Waste Facility Permit (EPA 1994, 1990) requires that "(I)f the Administrative Authority has reason to believe that a SWMU has released concentrations of hazardous wastes, or if the Administrative Authority determines that contaminants present a threat to human health and the environment given site-specific exposure conditions, or may

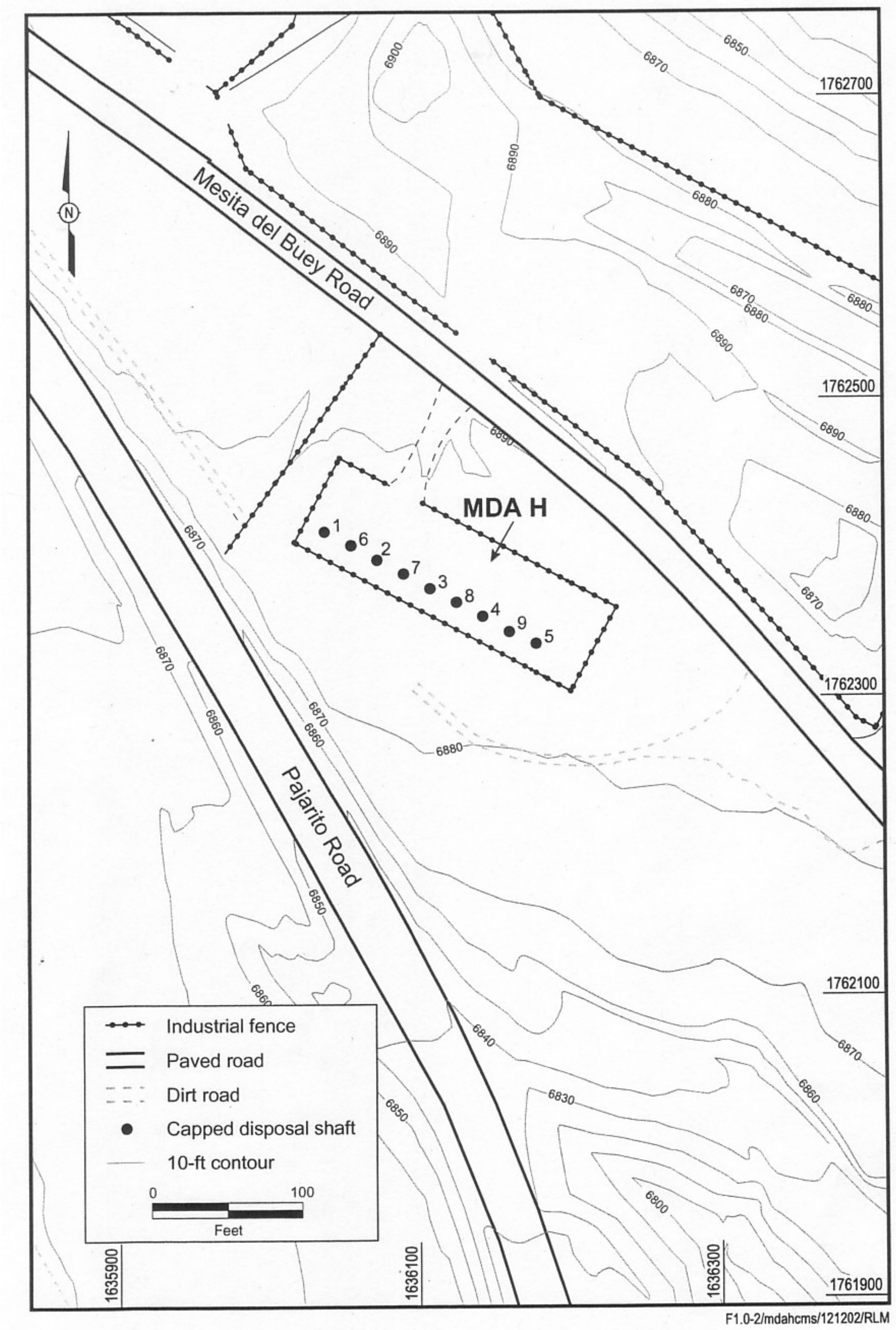

Figure 3. Locations of inactive disposal shafts at MDA H.

Resource Conservation and Recovery Act Corrective Action Process

***Resource Conservation and Recovery Act* (RCRA):** RCRA extends environmental protection to the land. This law sets forth an intent to promote conservation of resources through reduced reliance on landfilling. Both solid waste and hazardous waste are covered by this law. In RCRA, Congress established initial directives and guidelines for EPA to regulate hazardous wastes from generation to ultimate disposal. In 1984, Congress amended RCRA by passing the Hazardous and Solid Waste Amendments **(HSWA)**. In accordance with these provisions of HSWA, LANL's permit to operate hazardous waste treatment and storage units includes a section (called Module VIII or the "**HSWA Module**") that prescribes a specific corrective action program for LANL, which focuses primarily on the investigation and cleanup, if required, of inactive sites.

The HSWA Module specifies the following three-step corrective action process:

1. **RCRA Facility Investigation (RFI):** An RFI identifies the nature and extent of contamination at its source and the environmental pathways along which contaminants could travel to human and environmental receptors. This step characterizes the extent of contamination in the detail necessary to determine which corrective measure options could be effective in reducing any potential future adverse effects to human health and the environment from contaminant releases at a disposal site as a result of either intentional or unintentional disposal of wastes (such as from site spills or leaks). Characterization focuses on answering questions relevant to determining further actions in a cost-effective manner.

2. **Corrective Measures Study (CMS):** If characterization indicates that corrective measures are needed, a CMS evaluates potential corrective measure options that address potential unacceptable future risks and recommends one or more of those measures for implementation. These options are evaluated based on their projected ability to reduce risks to human and environmental health and safety in a cost-effective manner. Corrective measures considered in a CMS include monitoring components to confirm the effectiveness of the corrective measure option and define actions to be taken in the event that the corrective measure option implemented is ineffective.

3. **Corrective Measures Implementation (CMI):** A CMI implements the selected corrective measure option, verifies its effectiveness, and establishes ongoing control and monitoring requirements, if needed.

present a threat over the lifetime of the wastes, the Administrative Authority may require a CMS and shall notify the permittee in writing." NMED, as the regulatory Administrative Authority for RCRA-regulated hazardous waste in New Mexico, determined that MDA H wastes could present such a future threat to human health and the environment and informed DOE and UC in a letter dated December 27, 2000, of the need to prepare a CMS (Young 2000).

The CMS Report (LANL 2003) was subsequently developed for MDA H; both hazardous waste constituents and radioactive waste constituents were considered in the CMS. The MDA H CMS Report describes the evaluation and decision approaches used to demonstrate the need for, and the components of, various corrective measures that would be suitably protective of human health and the environment with regard to the long-term management of these wastes and also identifies a preferred corrective measure for the wastes present at MDA H. The MDA H CMS Report is based on EPA, NMED, and DOE human health and environmental dose and risk assessment guidance. At its conclusion, the MDA H CMS is fully documented in a report (LANL 2003) available for public review and comment. The final selection of the corrective measure option to be implemented is made by the NMED. To ensure continued compliance with RCRA and the *New Mexico Hazardous Waste Act* requirement, both pre-construction approval and approval of the CMI Plan would be requested of NMED at the same time. The CMI Plan would include all components of the corrective measure action, including all staging areas, waste handling areas, and other support structures required to implement the corrective measure activity. NMED would approve all the engineering drawings, specifications, and the adequacy of other relevant information before any corrective measure option selected by NMED could be undertaken. DOE, NNSA must now make a decision on implementing a corrective measure for MDA H.

1.3 Purpose and Need for Agency Action

DOE, NNSA has the Congressionally assigned responsibility for the administration of LANL, including the management of radioactive and hazardous wastes generated by LANL mission support activities. As a result of historical LANL waste disposal practices, wastes disposed of within shafts at MDA H have been identified by NMED as potentially having a future adverse effect on human health and the environment. A CMS Report prepared for MDA H evaluated various corrective measure options for MDA H. DOE now needs to implement a corrective measure for MDA H so as to comply with the legal requirements of RCRA and the *Atomic Energy Act of 1954*.

1.4 Scope of This EA

A sliding-scale approach (DOE 1993b) is the basis for the analysis of potential environmental and socioeconomic effects in this EA. That is, certain aspects of the Proposed Action have a greater potential for creating environmental effects than others; therefore, they are discussed in greater detail in this EA than those aspects of the action that have little potential for effect. For example, implementation of the Proposed Action could affect waste management resources at LANL. This EA, therefore, presents in-depth descriptive information on these resources to the fullest extent necessary for effects analysis. On the other hand, implementation of the Proposed Action would cause no effect on threatened and endangered species at LANL. Thus, a minimal description of effects to this resource is presented.

When details about an action alternative are incomplete, as a few are for the action alternatives evaluated in this EA, a bounding analysis is often used to assess potential effects. When this approach is used, reasonable maximum assumptions are made regarding potential aspects of project activities (see Sections 2.0 and 3.0 of the EA). Such an analysis usually provides an overestimation of potential effects. In addition, any proposed future action(s) that exceeds the assumptions (the bounds of this effects analysis) would not be allowed until an additional NEPA review could be performed. A decision to proceed or not with the action(s) would then be made. For example, groundwater remediation, if required, would be the subject of additional NEPA review.

1.5 Public Involvement

NNSA provided written notification of this NEPA review to the State of New Mexico, the four Accord Pueblos (San Ildefonso, Santa Clara, Jemez, and Cochiti), Acoma Pueblo, the Mescalero Apache Tribe, and to over 30 stakeholders in the area on December 13, 2002. In addition, upon release of this draft EA, NNSA will allow for a 30-day comment period. Where appropriate and to the extent practicable, concerns and comments will be considered in the final EA.

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2.0 Description of Proposed Action and Alternatives

This section discusses the Proposed Action and a No Action Alternative. Section 2.1 describes the site and characteristics of MDA H and includes summary information about site investigations and characterization and the waste inventory at MDA H. Section 2.2 describes the Long-Term Environmental Stewardship Program. Section 2.3 describes the No Action Alternative as a baseline for comparison with the consequences of implementing the Proposed Action. Section 2.4 describes the Proposed Action for the EA that would allow NNSA to meet its purpose and need for agency action. The Proposed Action, implementing a corrective measure at MDA H, has five corrective measure options. There are three containment corrective measure options, discussed in Section 2.4.1, and two excavation and removal corrective measure options, discussed in Section 2.4.2.

Because the MDA H RFI report (LANL 2001a) identified no unacceptable present-day risks to human health or the environment and no unacceptable dose levels from radiological contaminants at MDA H, the potential need for corrective action at MDA H is based on future potential for releases that might create unacceptable risks or doses to human health or the environment. Thus, the proposed corrective measure options emphasize confirmation of continuing absence of releases, controlling the sources that could contribute to releases, and providing containment that would ensure the magnitude of potential future releases would be within acceptable risk and dose levels.

As stated earlier, the final selection of a corrective measure option would be made by the NMED, which has been delegated RCRA corrective action authority from the EPA. NMED is not obligated to select any one of the five corrective measure options analyzed in this EA, but could choose a combination of corrective measures or a totally different corrective measure option. The corrective measure options analyzed in this EA address a range of potential containment and excavation options and are intended to be representative of corrective measures that could be implemented at MDA H. This EA analyzes the potential environmental consequences of implementing corrective measure options consistent with RCRA requirements, EPA guidance, the HSWA permitting process, DOE policy, and other applicable regulations. In accordance with HSWA requirements, corrective measure options selected for this analysis are based on the information developed in the RFI and are intended to provide a bounding analysis of the potential environmental effects of implementing any corrective measure option at MDA H.

This EA incorporates, by reference, the MDA H RFI Report (LANL 2001a) and Addendum (LANL 2002a, 2001a), the CMS Plan (LANL 2001b), and the CMS Report (LANL 2003) submitted to NMED by DOE and UC at LANL. Detailed information on the MDA H investigation, site characteristics, waste inventory, corrective measures screening process, corrective measure options, and waste handling procedures can be found in the MDA H RFI Report (LANL 2001a) and Addendum (LANL 2002a, 2001a) and in the CMS Report (LANL 2003). Copies of these reports may be reviewed in Los Alamos, New Mexico, at the DOE Reading Room in the Community Relations Office located at 1619 Central Avenue, and in Santa Fe, New Mexico, at the Northern New Mexico Citizens Advisory Board located at 1660 Old Pecos Trail, Suite B. Information pertinent to the analysis of the environmental consequences of the Proposed Action is included in this EA. Should the corrective measure chosen by NMED prove to have environmental effects that are not bounded by this EA analysis, DOE will pursue an additional NEPA compliance review.

2.1 Site Description and Characteristics of MDA H

As previously stated, TA-54 is located in the east-central portion of LANL on Mesita del Buey between Pajarito Canyon (south) and Cañada del Buey (north). Access to TA-54 and Pajarito Road is restricted. MDA H, designated SWMU 54-004 under the RCRA corrective action process, is a 70-ft (21-m) by 200-ft (60 m) fenced area (0.3-ac [0.12 ha]) (Figure 4). The site is not located near any existing structures or paved vehicle parking areas. The area near MDA H is considered to be a developed area with unpaved access roads and unpaved parking areas. No floodplains, wetlands, or sensitive species habitat areas are located nearby. A complete description of the natural characteristics of the MDA H setting is provided in Appendix B of the MDA H RFI Report (LANL 2001a).

MDA H consists of nine inactive vertical disposal shafts arranged in a row about 15 ft (4.5 m) inside its southern fence (see Figure 3). Each shaft is cylindrical with a diameter of 6 ft (1.8 m) and a depth of 60 ft (18 m). Shafts at MDA H are located more than 90 ft (27 m) from the south rim of Mesita del Buey, which puts them outside the zone of increased susceptibility for mesa edge failure (see Geology, Section 3.5). One shaft, shaft 9, has an existing 6-ft (1.8-m) concrete cap; the remaining shafts are capped with 3 ft (0.9 m) of concrete covered with 3 ft (0.9 m) of crushed tuff[8] material. The entire MDA site, including the shafts and caps, is covered

Figure 4. Material Disposal Area H at TA-54. (The mound of soil in the right forefront of the photo is clean fill remaining after the excavation of the last shaft.)

[8] "Tuff" is locally available consolidated (or "welded") volcanic ash that covers the Pajarito Plateau. Tuff is a relatively soft, porous rock varying in size from fine sand to coarse gravel and is usually formed by the compaction and cementation of volcanic ash or dust.

with a layer of soil. The concrete caps were brought to grade level with crushed tuff placed above the caps. The exact condition and the calculated life span of the caps over the MDA H shafts have not been determined. There are many factors that affect the performance of concrete and its life span of service; concrete actually cures harder over years of existence. The concrete shaft caps at MDA H are buried under about 3 ft (0.9 m) of tuff and soil so their exposure to weathering events and circumstances is very limited or not present. Prior to the initiation of any of the corrective measures that would leave wastes in place at Area G, the covering soil would be removed and the condition of the caps would be assessed. If the caps need to be replaced, they would be replaced with high performance concrete caps.

The surface of MDA H (including the shaft caps) is vegetated with native[9] grasses and herbaceous plants that stabilize the soil against erosion. In addition, the surface is contoured to redirect storm water runoff around the site and into a single surface drainage feature to Pajarito Canyon. No saturated ground conditions were encountered during installation of the shafts. The shafts were used between 1960 and 1986 for the disposal of classified solid-form waste generated by LANL operations. MDA H contains both radioactive and hazardous wastes including, but not limited to, plutonium, tritium, uranium, metals, and HE.

The site-specific aspects of the natural setting of MDA H (discussed in more detail in Chapter 3 of this EA) that are important to assessing the potential future impacts posed by releases of contamination to surface and subsurface media include the following:

- A very thick, relatively dry, unsaturated zone helps to limit downward migration of dissolved inorganic contaminants (metals and radionuclides, excluding tritium) in the liquid phase through the vadose zone (the zone of aeration in the earth's crust above the groundwater level where water in vapor form may be located) to the regional aquifer. The deepest borehole adjacent to MDA H is 300 ft (90 m) and no saturated conditions have been encountered. The regional aquifer is about 1,000 ft (300 m) below MDA H based on data from regional well R-20, located in Pajarito Canyon about 0.5 mi (0.8 km) southeast of MDA H;
- A semiarid climate with low precipitation and a high evapotranspiration (ET)[10] rate limits the amount of moisture percolating into the disposal units, subsequently limiting the amount of water available to leach[11] radionuclides or hazardous constituents; and
- Infrequent soaking rains and episodic rainfall events.

2.1.1 Site Investigation and Characterization

The nature and extent of contamination in the vicinity of MDA H were characterized during the RFI Report (LANL 2001a) and addendum (LANL 2002a, 2001a). During the RFI, samples of tuff and pore gas were collected from boreholes around the disposal shafts, and sediment

[9] The resident plant species that evolved within, or naturally dispersed to, various vegetation zones at LANL are "native" or "indigenous" species.
[10] ET is the combined discharge of water from the earth's surface to the atmosphere by evaporation from lakes, streams, and soil surfaces, and by transpiration (giving off water vapor) from plants.
[11] Leach, as used in this EA, refers to a material or element being dissolved by and carried away with liquid water into the surrounding environment.

samples were collected from the drainage channel receiving runoff from the site. The results of the RFI indicate there have been no releases of radionuclides or hazardous constituents associated with runoff from the site or infiltration of water through the disposal shafts. The RFI results, however, indicate subsurface releases of radioactive tritium (in the form of water vapor) and trace amounts of volatile organic compounds (VOCs) from the shafts associated with vapor phase transport. The levels of tritium and VOCs detected during the RFI were extremely low and do not pose a potential current risk to human health and the environment. The extent of this contamination was found to be limited to the immediate vicinity of the disposal shafts.

A CMS was requested by the NMED-Hazardous Waste Bureau (Young 2000) to ensure future potential impacts from the site remain low. DOE and UC at LANL submitted a CMS Plan (LANL 2001b) to NMED proposing approaches to determine the need for and the features of corrective measures options. As part of the CMS, contaminant fate and transport modeling was performed to evaluate the expected performance of corrective measure Option 1. The result of this modeling was that no transport of contaminants from the disposal shafts to surface water or groundwater would be likely over a 1,000-year evaluation period. It was concluded by inference that results for corrective measure Options 2 and 3 would be even better. The CMS Plan was approved by DOE and NMED in December 2001 (Young 2001).

A 1,000-yr performance period was evaluated for corrective measure options consistent with the performance assessment requirements for LLW disposal sites contained in DOE Order 435.1. The worker risk and dose assessments in the CMS Report (LANL 2003) are based on the projection that DOE would maintain institutional control of MDA H for the next 100 years, thereby limiting potential exposures to people living outside DOE's controlled area. It is possible that DOE may not maintain institutional control beyond a timeframe of 100 years. Therefore, the MDA H human health risk assessment also considers the potential for people to be exposed on or near MDA H once 100 years have elapsed. The potential for the loss of institutional controls after 100 years is consistent with performance assessment requirements for LLW disposal sites contained in DOE Order 435.1.

2.1.2 Estimated Inventory

A review of logbook and process descriptions along with personnel interviews was performed during the CMS to improve the accuracy of the estimated inventory in MDA H. These efforts resulted in a revised estimate of the waste inventory (LANL 2003, Omicron 2003). The approximate percentages by weight of material disposed of in the shafts at MDA H are shown in Figure 5.

About 33 percent of the MDA H waste inventory is metal objects including beryllium, copper, and enriched uranium fuel elements. As described in the logbook entries, DU comprises about 24 percent of the total waste inventory. Radioactive materials, other than DU, make up an additional 24 percent of the inventory. Radionuclides listed in the logbook entries include tritium; uranium-234, -235, -236, and -238; and plutonium-238, -239, -240, -241, and -242. Potentially reactive materials, such as lithium compounds and HE, each represent less than 1 percent of the inventory; these materials potentially meet the RCRA definition of characteristic hazardous waste. Graphite represents about 9 percent of the inventory. Additional materials, including plastics and recording media (such as paper documents, film, slides, and magnetic computer tapes), account for about 9 percent of the inventory (LASL 1960, Omicron 2003).

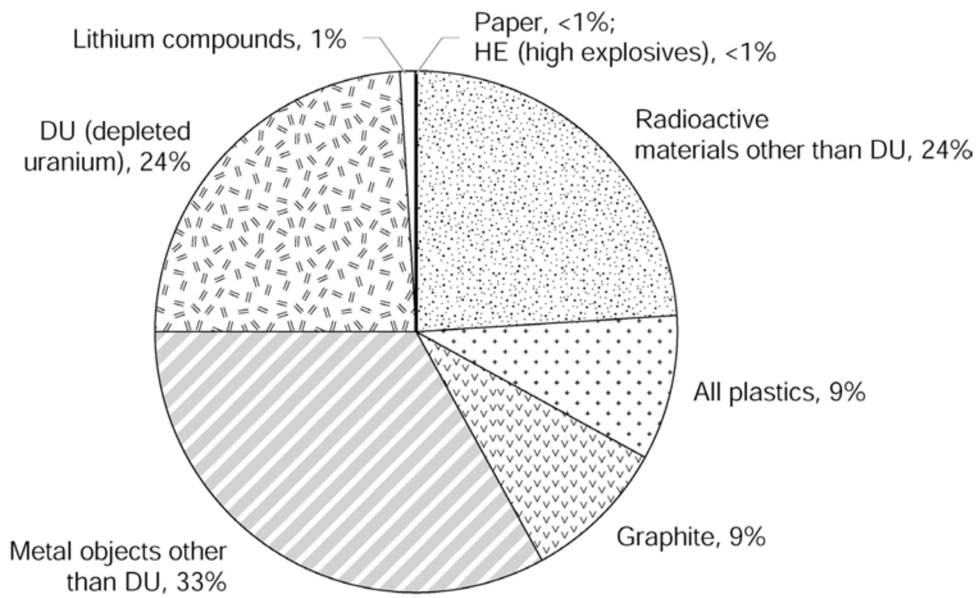

Figure 5. Breakdown of identified waste material disposed in shafts (approximate percentages by weight).

Potentially hazardous waste constituents not listed in logbook entries are anticipated to be present at MDA H based on process knowledge. These materials (barium, cadmium, chromium, lead, mercury, and silver) were used for shielding, solders, parts, or coatings. VOCs were not listed in the logbook entries but were detected in trace amounts in vapor phase sampling in the MDA H RFI boreholes (LANL 2002a).

2.2 Long-Term Environmental Stewardship Program

Depending on the corrective measure option ultimately selected and approved by the NMED, residual contamination could remain onsite after closure. For those options involving in-place containment of wastes (corrective measure Options 1, 2, and 3 and the No Action Alternative), physical controls (engineered barriers, such as caps and containment barriers) and institutional controls (such as access restrictions) would be required for generations to come. Because of the long-lived and hazardous nature of plutonium and other contaminants onsite, the risks posed by the breakdown or malfunction of an engineered barrier or institutional control could be potentially high. Consequently, one of the major challenges that has surfaced during the CMS process is incorporating long-term environmental stewardship requirements into the remedy decision-making process.

One of the key characteristics of the stewardship components is their interdependence. For example, physical controls would almost always require that the institutional or administrative controls designed to support them remain operational and functional. Likewise, monitoring and maintenance of both the physical controls and the institutional or administrative controls would be required to assess and ensure their performance. Information would need to be maintained about the physical and institutional or administrative controls, as well as the monitoring and maintenance records. Comprehensive periodic assessments would be conducted by examining well-kept records about stewardship controls and related monitoring and maintenance records.

The controlling authority (NMED) would likely require NNSA and UC at LANL to ensure that the stewardship controls remain in place, that they are maintained, that the necessary information is collected, and that the periodic assessment program is implemented and subsequent corrective actions are taken. As these examples show, no part of the stewardship program should be considered by itself.

The specific details of each stewardship component would necessarily depend on the corrective measure option selected. Therefore, details of the Long-Term Environmental Stewardship Program are not developed during the CMS, but the stewardship components are qualitatively

Components of a Long-Term Environmental Stewardship Program

These components of a **Long-Term Environmental Stewardship Program** work individually and collectively to ensure that the chosen corrective measure option remain protective of human health and the environment:

1. **Physical controls**: Physical controls include, but are not limited to, containment structures such as caps, water diversion and treatment systems, and access barriers such as fences, guards, and signs. These controls physically reside at the site of, or close to, the actual contamination.

2. **Institutional or Administrative Controls**: This category of controls includes governmental controls such as zoning, permits, and use restrictions; proprietary controls such as easements and covenants; legal enforcement tools such as administrative orders and consent decrees; and informational devices such as deed notices, registries, and advisories.

3. **Monitoring and Maintenance**: These components include periodic monitoring and maintenance of the selected corrective measure option and corresponding stewardship controls (whether physical or institutional and administrative).

4. **Information Management**: A successful stewardship program is dependent on retaining all necessary records about the site's history and residual contamination. Information that must be retained should include history of the site, the contaminants of concern, the selected corrective measure option, the use of controls along with their monitoring and maintenance records, and any other information judged necessary for succeeding generations to understand the nature and extent of the residual contamination.

5. **Periodic Assessment**: Periodic assessments are performed to determine whether the selected corrective measure option and stewardship controls continue to operate as designed, and to ascertain whether new technologies might exist to eliminate remaining residual contamination in a safe and cost-effective manner.

6. **Controlling Authority**: Long-term protection of human health and the environment necessitates that a controlling authority be established with responsibility for overall stewardship program management and guidance.

discussed together with the proposed option. Further guidance would be provided by the NMED as part of the Permit Modification decision in which an option is selected. Details of the final Long-Term Environmental Stewardship Program would then be developed by NNSA and UC at LANL as part of the CMI Plan for the selected option, which must be submitted to the NMED for approval.

2.3 No Action Alternative

The No Action Alternative, which in this case would be a continuation of the status quo, provides a description of current conditions to compare to the potential effects of the Proposed Action. The No Action Alternative is required by law and must be considered even if NNSA is under a court order or legislative command to act (10 CFR 1021.31[c]).

The CMS Report (LANL 2003) identified that the current design of the MDA H cover has been reliable and effective in preventing releases of wastes (with the exception of subsurface vapor releases of VOCs and tritium) from the shafts at MDA H. This cover has had minimal maintenance in its 40-year lifetime. If properly maintained, the existing cover should adequately perform its intended containment function. Contaminant transport modeling of the effectiveness of the existing cover demonstrated that no contaminants would be likely to reach the regional groundwater table beneath MDA H during the 1,000-year evaluation period.

Under the No Action Alternative, none of the corrective measure Options 1 through 5 described in Sections 2.4.1 through 2.4.2.2, would be undertaken at this site, although a Long-Term Environmental Stewardship Program would be implemented at the site. There would be only limited control of the amount of water that could percolate into the shafts and contribute to potential subsurface contaminant transport. Enhanced erosion controls to limit direct exposure of the waste and further minimize surface transport of contaminants would not be implemented. There would be a continuing potential for contaminant mobilization due to biotic intrusion of deep-rooting plants and burrowing animals and, potentially, human intrusion. Vapor-phase waste migration would continue to occur until all vapor phase waste were depleted and vapors were vented to the atmosphere, were bioconverted or decayed, or were diluted over time.

The need for implementation of a corrective measure at MDA H is based on future potential for releases that might create unacceptable risks or doses to human health or the environment. DOE is required by NMED through Module VIII of LANL's Hazardous Waste Facility Permit (EPA 1994, 1990) to perform site characterization and cleanup. Under the No Action Alternative, DOE, NNSA would not implement site remediation and would not comply with the requirements of Module VIII of LANL's Hazardous Waste Facility Permit. In addition, NNSA and UC at LANL activities would not comply with the requirements of Sections 3004(u) and (v) of RCRA, the *Atomic Energy Act of 1954*, and other applicable laws, regulations, and DOE orders.

2.4 Proposed Action

The Proposed Action is to implement a corrective measure at MDA H within TA-54. The CMS Report identified five corrective measure options (Table 1), each of which would meet the CMS

Table 1. Corrective Measure Options for the Proposed Action

Containment Corrective Measure Options
Corrective Measure Option 1: Upgrade Existing Surface
Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover
Corrective Measure Options 3 a and b: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover
Excavation and Removal Corrective Measure Options
Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal
Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Plan's corrective action objectives[12] (see text box); these five corrective measure options range from the relatively simple to implement to the more complex actions with correspondingly increased cost and more complex implementation requirements. This EA analyzes effects for three waste containment corrective measure options and two conceptual waste excavation and removal corrective measure options as part of the Proposed Action. The corrective measure options analyzed in this EA address a range of potential containment and excavation options and are intended to provide a bounding analysis of the potential environmental effects of implementing any corrective measure option at MDA H. The corrective measure option preferred by DOE is corrective measure Option 2, Replacement of the Existing Surface with an engineered ET cover. This corrective measure option was proposed for implementation to the State in the draft CMS Report (LANL 2003).

General Measures

Work at MDA H for any of the five corrective measure options could require the use of heavy equipment such as drill rigs, cranes, cement trucks, dump trucks, trackhoes, excavators, front-end loaders, and backhoes. Corrective measure options involving waste excavation could also require the use of a conveyor system and remote-handling equipment. Equipment would operate primarily during the daylight hours and would be left onsite over night. During site activities, space in the immediate vicinity would be required for vehicle parking,

Corrective Action Objectives Identified in the CMS Plan

In accordance with Module VIII of LANL's Hazardous Waste Facility Permit (EPA 1990, 1994) and the MDA H CMS Plan, any corrective measure option considered for implementation at MDA H must satisfy the following **corrective action objectives** established in the CMS Plan:

- protect human health,
- protect the environment,
- attain action levels (provide reasonable assurance that the potential migration of contaminants would not result in contaminant concentrations in the environment high enough to warrant an action),
- control the source of potential contamination to reduce or eliminate releases that may pose a threat to human health or the environment, and
- comply with all applicable waste management requirements.

[12] The corrective action objectives listed in the text box in Section 2.3 of this EA must be satisfied for any corrective measure option developed for MDA H. The corrective measure action objectives were based on the EPA RCRA Corrective Action Plan (EPA 1994) and the DOE RCRA Corrective Action Plan Program Guide (DOE 1993c).

equipment storage, and material staging. Existing site controls (such as fencing) would limit unauthorized public access.

Before the start of any construction activities, utilities along Mesita del Buey Road would be modified. The water lines supplying Areas G and L would be upgraded by the addition of pressure sensors and automatic shutoff valves to the two subsurface water lines located north of MDA H. If a loss in pressure were detected by the pressure sensor, the line would automatically be shut off, thereby minimizing the potential for flooding of the MDA H shafts in the event of a water line break nearby along Mesita del Buey Road.

After the utilities have been upgraded, a single construction trailer for use by site workers would be placed within the staging area. The staging area for heavy equipment, vehicles, and the construction trailer (office) would be installed near the MDA H work site and would cover about 7,500 square feet (ft^2) (675 square meters [m^2]). Utilities would be made available to the construction site by hooking up to the existing water and electric utilities along Mesita del Buey and Pajarito roads. Portable toilets would be installed near the construction trailer in the staging area and next to the sorting and declassification facility that would be installed if an excavation and removal corrective measure option was selected. Office waste generated by site workers would be disposed of at the Los Alamos County Landfill or its replacement facility. Sanitary waste would be trucked offsite and disposed of by the company supplying the portable toilets.

Site activities at MDA H have the potential to generate dust. Standard dust suppression methods would be used onsite to minimize the generation of dust during site activities; such methods could include water spraying or the use of other types of dust suppression materials. New Mexico Ambient Air Quality Standards and the National Ambient Air Quality Standards (NAAQS) for total suspended particulate emissions[13] would be met throughout any corrective measure activities by maintaining particulate emissions below the 24-hour permissible level of 150 micrograms per cubic meter and below the annual perimeter level of 50 micrograms per cubic meter in ambient air.

Site work would be planned and managed to ensure standard worker safety goals are met and work would be performed in accordance with good management practices, regulations promulgated by the Occupational Safety and Health Administration (OSHA), and applicable DOE orders involving worker and site safety practices. Onsite workers would park their personal vehicles either in existing parking lots nearby or in other designated parking areas at MDA H. All site construction contractors would be required to submit and adhere to a Construction Health and Safety Plan. Applicable safety and health training and monitoring, personal protective equipment (PPE), and work-site hazard controls would be required for workers at MDA H. A peak staff level of about 10 to 85 workers would be actively involved in activities such as site preparation, earthmoving, and heavy equipment work, depending on the final corrective measure option chosen and the overall sequencing of construction, excavation, and sorting activities. Site corrective measure implementation activities could begin as early as 2004 and take between six and forty-eight months to complete, depending on the corrective

[13] Total suspended particulate emissions are now referred to as PM_{10}; PM_{10} is particulate matter of 10 microns or less in diameter.

measure option chosen. Potential exposures to various physical, chemical, HE, and radiation hazards or injuries would be possible during these activities.

All corrective measure options of the Proposed Action would be conducted in accordance with LANL's requirements for waste management (LANL 1998a) specifying that the generation of any operational waste shall be reduced as much as technically and economically feasible. Generated and recovered wastes would be segregated, recycled, and reduced to the greatest practical extent.

For corrective measure options that include waste excavation and removal, the most efficient, safe, and appropriate means of handling waste would be determined. Site activities would be conducted in accordance with DOE Orders 435.1, "Radioactive Waste Management," 5400.5, "Radiation Protection of the Public and the Environment," and 10 CFR 830, "Nuclear Safety Management," which defines the requirements for Document Safety Analysis (DSA) approval by DOE before UC staff at LANL could excavate MDA H. Remote handling and other appropriate site waste removal technologies and techniques would be employed at MDA H.

Best management practices (BMPs) for soil erosion control purposes would be implemented, as necessary, for any site remediation activities involving soil disturbance. BMPs could include runon and runoff controls, such as straw bales, silt fencing, ditching, and similar storm water flow controls. Special air pollution control technologies would be applied as necessary and appropriate. A National Pollutant Discharge Elimination System (NPDES) General Permit Notice of Intent would be filed, if required, based on the corrective measure option chosen for implementation. A Storm Water Pollution Prevention Plan would be required for the construction activity.

2.4.1 Containment Corrective Measure Options

Containment corrective measure Options 1, 2, and 3 would leave the waste undisturbed within the MDA H shafts and would make changes to the disposal area cover[14] and individual shaft caps.[15] Construction activities would be confined to the immediate area surrounding MDA H. The following elements are common to corrective measure Options 1, 2, and 3:

- All three corrective measure options would rely on the use of ET;
- the existing waste inventory would remain undisturbed in the shafts;
- the MDA H site would remain fenced to provide a measure of protection against disturbance of the caps, existing cover, and vegetated surface for a period of at least 100 years; and
- the MDA H site would have regular monitoring and maintenance inspections for at least 100 years, including periodic examination of the surface for any excessive erosion or gullying, ponding of water, and condition of the vegetative cover. Maintenance would be performed, as necessary, to maintain the required site surface condition.

[14] "Cover" refers to a soil layer placed over the entire disposal area.
[15] "Cap" refers to concrete seals or plugs placed at the tops of the shafts.

The useful life of a new cover could be extended indefinitely if the cover were maintained properly and if site access was restricted. Even with loss of institutional controls (fences and human access restrictions), 3-ft- (0.9-m-) thick concrete caps and ET covers would not be expected to erode away over a 1,000-year evaluation period (corrective measure Options 2 and 3) according to containment modeling estimates.

2.4.1.1 Corrective Measure Option 1: Upgrade Existing Surface

Corrective measure Option 1 would include a minor upgrade to the existing MDA H surface and implementation of a Long-Term Environmental Stewardship Program, as described in Section 2.2. The existing concrete and tuff shaft caps that provide a barrier to intrusion by plants or animals (biointrusion) would be retained. The existing soil surface cover would be regraded and recontoured for improved storm water runon and runoff control. The surface of MDA H would be upgraded with the placement of about 6 inches (in.)[16] (15 centimeter [cm]) of gravel and soil mix on top of the existing soil surface and revegetated with shallow-rooting native grasses and herbaceous plants.

Implementation of this corrective measure option would take about six months and would cost about $214,000. Upgrades to the existing cover would be easily constructed. Regrading the site would be routine. The topsoil and gravel mulch that make up the cover would be easily obtainable nearby and relatively easy to install. A vegetative cover could be established within two years. The gravel and soil admixture would serve to control erosion of the cover while the vegetative cover was establishing itself in the topsoil beneath the gravel. Thereafter, the vegetative cover would provide additional erosion control and decrease infiltration of moisture through the cover by the process of ET. The topsoil would promote maximal plant coverage.

LANL personnel would provide monitoring and maintenance of site surface features that protect against severe erosion. Subsurface monitoring would be performed below the cover down to a depth of about 260 ft (78 m). The subsurface monitoring program would be designed to identify changes in soil and substrate moisture content. Monitoring would be performed using sensors placed at three depths below the cover in small-diameter shafts that would be bored at predetermined locations. These sensors would be used to determine whether moisture was moving through the cover. The moisture content in the tuff below the shafts would also be monitored using existing site boreholes. The site would have regular inspections and maintenance to ensure that the integrity of the vegetative cover is adequate to prevent excessive erosion of the surface cover, gullying, or ponding of water. Regrading, recontouring, and revegetation with shallow-rooting native grasses and plants would be performed, as necessary, to maintain the effectiveness of the surface cover.

2.4.1.2 Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

Corrective measure Option 2 would include the installation of an engineered ET cover with the implementation of a Long-Term Environmental Stewardship Program as described in Section 2.2. The design objectives of an engineered ET cover would be to 1) reduce the amount of water

[16] The actual cover thickness would be determined during final design based on estimates of the water holding or storage capacity of the soil and the amount of infiltrated water that has to be stored (Dwyer 2002).

that could percolate into shafts to further reduce the potential for subsurface contaminant transport over time; 2) further reduce erosion potential to limit risk of direct exposure of the waste; 3) further minimize surface transport of contaminants over the next 1,000 years; and 4) further reduce intrusion potential for deep-rooting plants and most burrowing animals.

The conceptual design of an engineered ET cover corrective measure option for MDA H is illustrated in Figure 6. The design is based on research conducted at LANL and Sandia National Laboratories/NM on engineered ET covers (LANL 1998b, Dwyer 2002). The vegetated ET cover was developed explicitly for landfills located in arid and semi-arid climates like Los Alamos. ET covers have been installed at over 36 landfill sites in the southwestern U.S. under the review of the EPA's Technology Innovation Office (the World Wide Web address is http://cluin.org/products/altcovers/usersearch/ lf_search.cfm) and have been found to be a superior alternative to conventional landfill covers in arid and semi-arid climates.

ET covers have been demonstrated to be reliable because they use "natural" climatic and vegetation ET conditions at the site to minimize downward water movement. The proposed engineered ET cover would consist of a topsoil and gravel layer planted with dense, shallow-rooting vegetation to reduce erosion and facilitate soil moisture removal by ET. The non-clay soil would absorb and hold moisture near the surface so that it could be evaporated or transpired. The thin layer of topsoil and gravel would control erosion without compromising the features of the ET cover. The topsoil and gravel mixture would also promote initial plant growth on the cover, further reducing runoff and erosion. Underneath this top layer would be a thick layer (about 3 ft [0.9 m]) of crushed tuff material. Biointrusion barriers, as shown in Figure 6, would be constructed of various materials, including cobbles (about 1 ft [0.3 m] in depth) or a single layer of metal chain-link fencing as has been effectively used before. The biobarrier would be placed immediately over the existing cap of the shafts at MDA H. A cobble barrier would be effective in inhibiting intrusion from most burrowing animals and most deep-rooted plants, whereas metal fencing would be effective against burrowing animals only. The functionality of the existing shaft caps would not be compromised by differential settlement or localized erosion. The engineered ET cover could be easily maintained by adding more topsoil and gravel mixture to areas that settle or erode over time.

Implementation of this corrective measure option would take about five months to implement and would cost about $348,000. An engineered ET cover would be easily constructed. The equipment and material required to construct the engineered ET cover are common construction materials that are readily available. It is estimated that the engineered ET cover could be designed and approved in three months while construction of the cover is estimated to take about two months. As with corrective measure Option 1, a vegetative cover could be established within two years.

2.4.1.3 Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Corrective measure Option 3 of the Proposed Action would include partial or complete encapsulation of the disposal shafts with the addition of new, engineered shaft caps and an engineered ET cover, along with the implementation of a Long-Term Environmental Stewardship Program as described in Section 2.2. This corrective measure option would enhance the existing shaft caps with additional concrete thickness and utilize currently available that could percolate into shafts to further reduce the potential for subsurface contaminant transport over time; 2) further reduce erosion potential to limit risk of direct exposure of the waste; 3) further minimize surface transport of contaminants over the next 1,000 years; and 4) further reduce intrusion potential for deep-rooting plants and most burrowing animals.

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ET covers have been demonstrated to be reliable because they use "natural" climatic and vegetation ET conditions at the site to minimize downward water movement. The proposed engineered ET cover would consist of a topsoil and gravel layer planted with dense, shallow-rooting vegetation to reduce erosion and facilitate soil moisture removal by ET. The non-clay soil would absorb and hold moisture near the surface so that it could be evaporated or transpired. The thin layer of topsoil and gravel would control erosion without compromising the features of the ET cover. The topsoil and gravel mixture would also promote initial plant growth on the cover, further reducing runoff and erosion. Underneath this top layer would be a thick layer (about 3 ft [0.9 m]) of crushed tuff material. Biointrusion barriers, as shown in Figure 6, would be constructed of various materials, including cobbles (about 1 ft [0.3 m] in depth) or a single layer of metal chain-link fencing as has been effectively used before. The biobarrier would be placed immediately over the existing cap of the shafts at MDA H. A cobble barrier would be effective in inhibiting intrusion from most burrowing animals and most deep-rooted plants, whereas metal fencing would be effective against burrowing animals only. The functionality of the existing shaft caps would not be compromised by differential settlement or localized erosion. The engineered ET cover could be easily maintained by adding more topsoil and gravel mixture to areas that settle or erode over time.

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2.4.1.3 Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Corrective measure Option 3 of the Proposed Action would include partial or complete encapsulation of the disposal shafts with the addition of new, engineered shaft caps and an engineered ET cover, along with the implementation of a Long-Term Environmental Stewardship Program as described in Section 2.2. This corrective measure option would enhance the existing shaft caps with additional concrete thickness and utilize currently available commercial encapsulation technologies combined with an engineered ET cover, such as the one described for corrective measure Option 2. Corrective measure Option 3a would include a vertical grout wall encircling the perimeter of the shafts; corrective measure Option 3b would completely encapsulate each individual shaft and would add a bottom cap to each shaft. The primary purpose of corrective measure Option 3 would be physical site security, to reduce the potential for both human and biotic intrusion, rather than for environmental protection. Corrective measure Option 3 could provide limited environmental protection by potentially reducing the migration of contaminants in the shafts by minimizing the potential for water to enter the shafts, thus minimizing the potential for contaminant transport into the surrounding tuff but the degree to which this might occur could not be substantiated. Both partial encapsulation of the shafts and complete encapsulation of the shafts are described in greater detail under corrective measure Option 3a and corrective measure Option 3b, respectively, in the following paragraphs.

The new shaft caps, ET cover, and the partial (corrective measure Option 3a) or complete (corrective measure Option 3b) vertical barrier would be designed to discourage biotic intrusion or human excavation into the disposal shafts over more than 1,000 years. Cement incorporated into an encapsulation matrix and the use of an ET cover and new caps over each of the shafts would make biotic intrusion extremely difficult. This technology would prolong the capability of the existing shaft configurations to inhibit potential intrusion events.

Both partial and complete encapsulation could limit air circulation within the mesa top because these corrective measure options would not allow air to move freely into the shafts. Disrupting air circulation through the natural soil and rock fractures could cause less evaporation to occur within the mesa, resulting in potentially higher shaft moisture levels and nullifying the benefits of the ET cover. Increasing moisture levels in the shafts may also create conditions favorable for the corrosion of uranium metal waste pieces (LANL 2003). Uranium metal can corrode by reacting with atmospheric water and oxygen. Corrosion in the presence of water can result in the formation of uranium hydride that is pyrophoric.[17] The amount of hydride production is correlated to the relative humidity (the higher the relative humidity, the higher the hydride production). Although some hydride production could occur in the shafts, the amount of oxygen present in the shafts is not sufficient to allow or sustain a hydride fire.

Implementation of corrective measure Option 3 would require construction of vertical barriers and an engineered ET cover. The necessary technologies are well established, including specific worker health and safety protocols. As discussed in corrective measure Option 2, an engineered ET cover would be easily constructed. Vertical barriers would be constructed using existing commercial technologies to drill shafts and to force a cement mixture under pressure into the surrounding tuff of the MDA H site. The engineered vertical barriers would be constructed either around the perimeter of the MDA H site and extend to a depth of about 30 ft (9 m) (corrective measure Option 3a) or around each waste shaft individually and extend to a depth of about 65 ft (19.5 m) (corrective measure Option 3b).

[17] Pyrophoric material is a material that will ignite spontaneously when exposed to oxygen. The concern with the presence of pyrophoric materials in the MDA H shafts is that they would ignite if exposed to the atmosphere.

The materials proposed for the vertical barriers in the two encapsulation corrective measure Options 3a and 3b would consist of a mixture of grout[18] or micro-concrete[19] incorporating the tuff already in place at the site. Bench-scale and pilot-scale studies would be required to develop a technologically feasible cement mixture that would meet specifications for construction of the barriers. To be effective over a long period of time, the cement mixture must remain both chemically and physically stable. Because there is the potential for decreased stability of the cement mixture due to chemical disequilbrium with the surrounding tuff, a cement mixture would be chosen to enhance chemical compatibility with the surrounding tuff. Although existing climatic and geological conditions at MDA H would likely cause the surrounding soil to remain dry over the geologic lifetime of the shafts, the cement mixture would be designed to resist water infiltration and minimize leaching as an added precaution to remain optimally protective.

The cement mixture of choice might also be injected into the tuff beneath the shafts from areas outside the shafts so that the material in the shafts would not be disturbed (corrective measure Option 3b). While the necessary slant drilling technologies are well developed to accomplish the drilling of perimeter holes through which to force the cement mixture into the tuff layer beneath the shafts, there is no method developed for determining completeness of the beneath shaft seal. However, since a primary objective of corrective measure Option 3 is to deter human or biotic intrusion, the correct cement mixture formulation would achieve this end, even though a 100 percent bottom seal may not be obtained.

The total time required for design and implementation of this corrective measure option, including bench-scale and pilot-scale tests and construction, would be about one year. An additional two years could be required to establish a vegetative cover. It is estimated that implementation of corrective measure Option 3a (partial encapsulation around the perimeter of the shaft field) would cost about $2,150,000 and that implementation of corrective measure Option 3b (complete encapsulation of each individual shaft, including below the bottom level of the shafts) would cost about $2,550,000. The increase in estimated cost is due to the time required to perform cutting operations at the bottom of the shafts to connect the boreholes surrounding the shafts. Current drilling technology is capable of lateral cutting with either a centrifugal or lateral drill toolset in softer materials such as tuff.

Corrective Measure Option 3a: Partial Shaft Encapsulation with Engineered Caps and an Engineered ET Cover

Corrective measure Option 3a of the Proposed Action would be the implementation of partial shaft encapsulation with new shaft caps and an engineered ET cover. The tops of the shafts would be covered with the placement of an engineered ET cover, as described in corrective measure Option 2, and new engineered shaft caps; a vertical sidewall barrier would be constructed at a predetermined depth and width around the perimeter of the MDA H site. Existing technologies could place the barrier to a depth of about 30 ft (9 m). The thickness of the barrier could be varied from 2 to 3 ft (0.6 to 0.9 m) and may be reinforced with steel. The sidewall barrier would be formed by injecting a cement slurry mixed with powdered native tuff into the subsurface under pressure. The primary intent of the sidewall barrier would be to discourage human intrusion and to restrict plant roots and animals from penetrating the disposal

[18] Grout is composed of cement and additives.
[19] Micro-concrete consists of finely ground cement and sand.

shafts. Figure 7 is a conceptual view of the partial shaft encapsulation corrective measure option for MDA H.

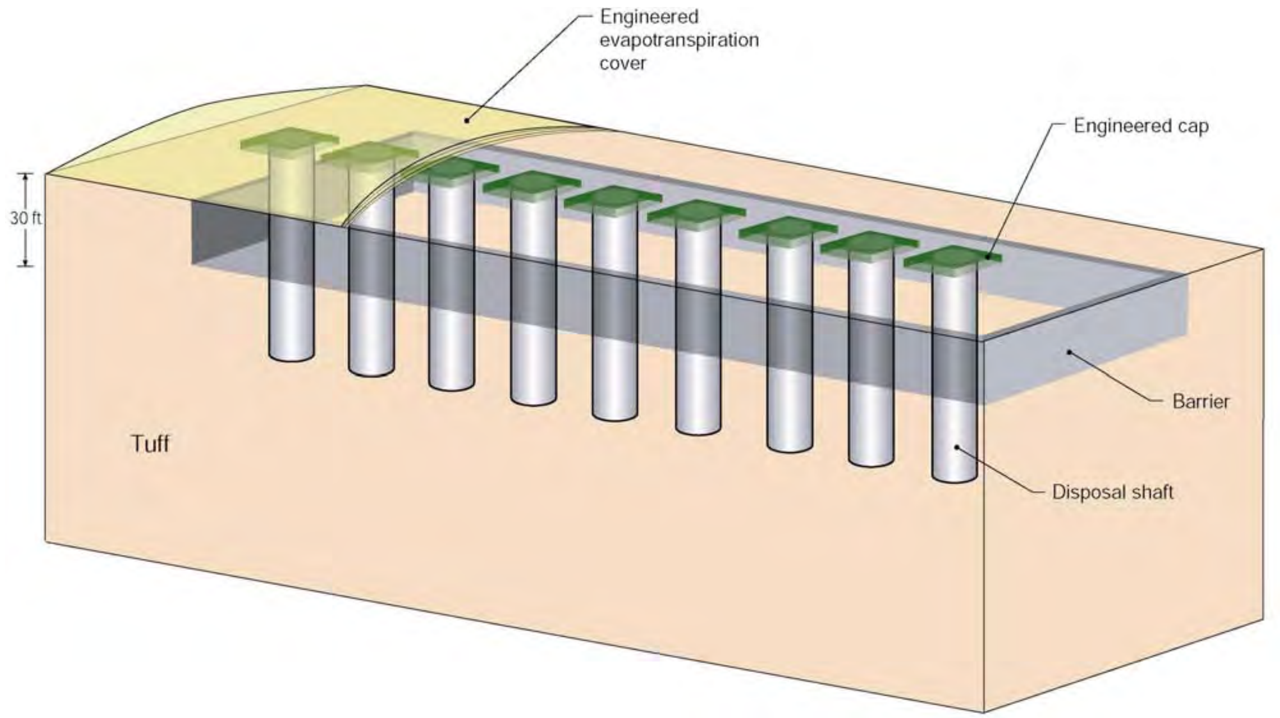

Figure 7. Partial encapsulation with engineered caps and an engineered ET cover.

Shaft 9 would not receive a new cap, as this individual shaft already has a 6-ft (1.8-m) concrete cap. The other eight shafts would have the 3 ft (0.9 m) of tuff that currently makes up part of their caps supplemented with an additional 3 ft (0.9 m) of concrete to form the new engineered shaft caps.

Corrective Measure Option 3b: Complete Shaft Encapsulation with Engineered Caps and an Engineered ET Cover

Corrective measure Option 3b of the Proposed Action would be the implementation of complete encapsulation of each shaft with new engineered top shaft caps and an engineered ET cover, together with bottom caps beneath the shafts. The complete shaft encapsulation corrective measure option (corrective measure Option 3b) would, if successful, offer the maximum protection against plant, animal, and human intrusion and water infiltration, but may enhance water vapor trapping beneath the ET cover. A perimeter side vertical barrier would be constructed around each individual waste shaft at MDA H to a depth of about 65 ft (19.5 m). To form the new perimeter side vertical barrier, interlocking boreholes, 2 to 3 ft (0.6 to 0.9 m) in diameter, would be constructed around the perimeter of each existing waste shaft by using a rotary drilling rig, without actually drilling into or disturbing the contents of the shaft. As each new borehole was completed around the perimeter of an existing MDA H shaft, a cement slurry, or other grout mixture, as appropriate, would be injected into the newly completed borehole by commercially available pressure grouting techniques. A predetermined area below the bottom of each shaft would also be injected with slurry or grout to form a bottom shaft barrier, or cap, using the pressure grouting techniques described for the sidewall boreholes. The borehole cuttings would be stockpiled as crushed tuff for use in the final cap onsite.

The tops of the shafts would be engineered with the placement of a new ET cover, as described in corrective measure Option 2, and new 3-ft (0.9-m) engineered concrete caps. Shaft 9 would not receive a new top cap, as this individual shaft already has a 6-ft (1.8-m) concrete cap, but would receive an engineered bottom cap. Figure 8 provides a conceptual view of the shaft complete encapsulation corrective measure option for MDA H.

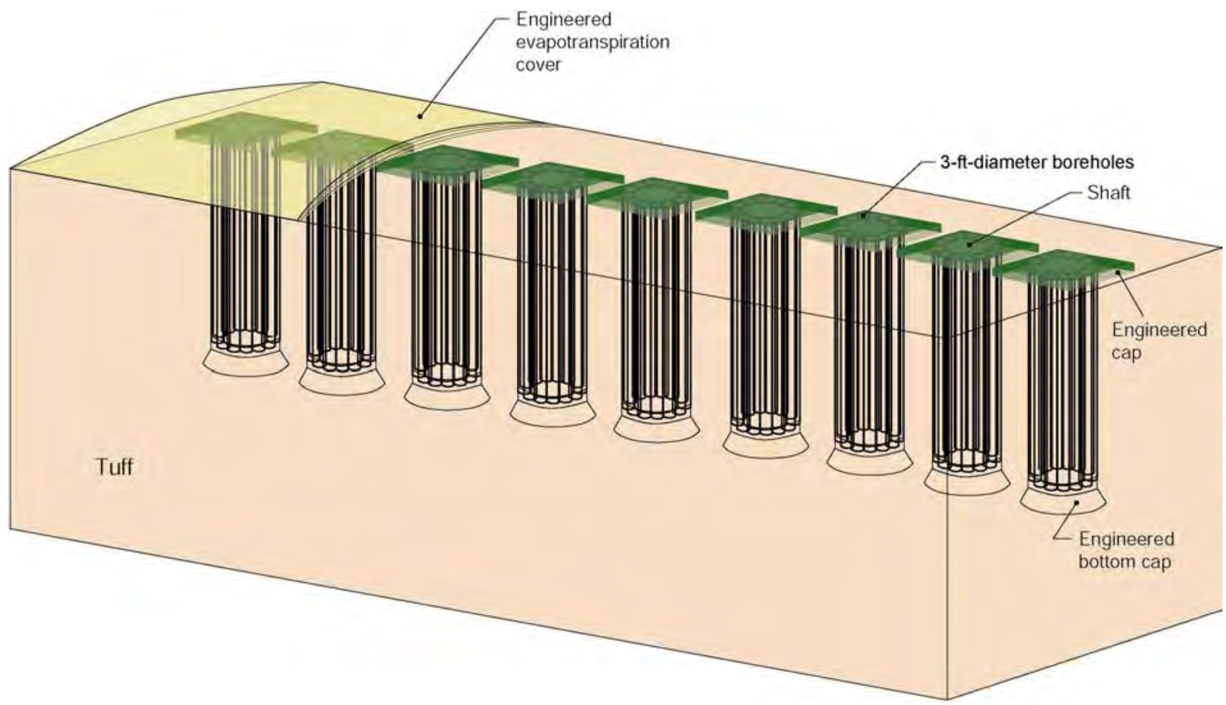

Figure 8. Complete encapsulation with engineered caps and an engineered ET cover.

2.4.2 Excavation and Removal Corrective Measure Options

Corrective measure Option 4 (with maximal offsite disposal) and corrective measure Option 5 (with maximal onsite disposal) of the Proposed Action would include the complete excavation and removal of all waste from MDA H. The information and descriptions provided for both corrective measure Options 4 and 5 are based on conceptual designs for the excavation and removal activities. If NMED were to select either of these corrective measure options, a detailed engineering study, complete hazard categorization and safety analysis would be required for implementing these corrective measure options. Appropriate nuclear safety analyses, authorization basis, security measures, and a site-specific security plan would also be developed, approved by DOE, NNSA, and implemented before site work commenced.

Many of the activities of corrective measure Options 4 and 5 would have to be conducted outside the primary waste management area of MDA H. The specific engineering controls required for the sorting, declassification, and packaging structure would be established during the safety analysis and implemented at the site. Based on the types of materials to be handled, it is expected that high-efficiency particulate air (HEPA) filtration would be required in any waste handling structure.

The conceptual MDA H excavation footprint[20] surrounded by a security fence is shown in Figure 9; a close up of the conceptual MDA H excavation footprint is shown in Figure 10. Implementing either corrective measure Options 4 or 5 would result in disturbing an area of about 10 ac (4 ha).

As shown in Figures 9 and 10, the following construction of support structures and site area modifications would likely be required to implement either of the two proposed complete waste excavation corrective measure options:

- construction of a waste sorting and declassification structure including a storage vault (about 5,600 ft^2 [504 m^2]),
- erection of excavation tenting and moisture protection over the shaft area,
- installation of an enclosed conveyor system (about 100 ft [30 m] long, 14 ft [4.2 m] wide, and 15 ft [4.5 m] tall),
- establishment of an overburden storage area (about 52,000 ft^2 [4,680 m^2]) for soil, tuff, and other material excavated from around the disposal shafts,
- relocation and expansion of the site security fence with controlled access (about 5,000 linear ft [1,500 m]), and
- blading of an access road (about 2,000 ft [600 m] long) between the sorting and declassification facility and the new overburden storage area.

Corrective measure Options 4 and 5 would involve specific waste management requirements that would be incorporated into procedures documented in the security plan and implemented at the site. All excavation and declassification activities would be conducted consistent with this security plan. For site physical security purposes, wastes could be moved only a short distance from the point of excavation to a screening, sorting, and declassification area. Temporary security enclosures could be constructed in the area designed for sorting, declassification, characterization, and packaging operations (Figure 9).

Construction

If either excavation and removal corrective measure option were selected, additional support structures and a new access road could likely be required. After the access road was bladed, the waste sorting and declassification facility would be constructed as needed. This facility would conceptually be located about 60 ft (18 m) southeast of MDA H. Portable toilets could also be installed at this location.

[20] Footprint in this EA refers to the outline or indentation made by excavation activities on the surface of the ground.

In preparation for transporting the wastes removed from the shafts, an enclosed conveyor system about 100 ft (30 m) long, 14 ft (4.2 m) wide, and 15 ft (4.5 m) tall would potentially be installed. The conveyor system could be sized so that it would be large enough to convey the shaft wastes in an inert[21] atmosphere, if required. The proposed conveyor system could consist of a series of glove-box-type units terminating in an inert atmosphere visual inspection station (Figure 11).

Figure 11. Example of a remotely operated dismantling system and inspection station.

As needed, the inspection station could consist of the last 30 ft (0.9 m) of the conveyor system located furthest away from the shafts. If constructed, the remotely controlled visual inspection station would contain manipulator arms, tools, and equipment necessary to determine certain characteristics (such as weight, radioactivity, hazard level, and other important features) of each piece of the wastes removed from the shafts so that a path forward for excavated items, including potentially reactive items that must be further maintained in an inert atmosphere, could be identified. The inspection station could also be equipped with remotely controlled cutters and shredders or other shape deformers, as appropriate, so that dismantling or declassification of certain waste items could be performed. After inspection of the waste was performed, the enclosed conveyance system would move wastes into a packaging and sorting area and, after sorting, move the wastes into appropriate waste containers for recycling, further declassification, or other means of disposal depending on the waste characteristics.

[21] Inert means unreactive. An inert atmosphere can be obtained through the use of either gaseous or liquid nitrogen.

The overburden storage area would be constructed about 900 ft (300 m) southeast of MDA H. The security fence would be constructed around the perimeter of the entire work area. All new support structures, including the staging area and the access road, would be located within the secure area. Controlled access gates would be located, as necessary, at the site perimeter.

Operations (Corrective Measure Options 4 and 5)

Implementation of corrective measure Options 4 or 5 could require the application of various administrative and engineering controls, periodic road control, and specialized equipment or other tools such as shaft and pit stabilization devices, blast shields, earthen berms, remote video surveillance, use of inert gases onsite, and radiation monitors. If an excavation and removal corrective measure option were selected, it would be necessary to first perform a DSA, as required by 10 CFR 830. The safety basis process under 10 CFR 830 requires that the scope of work be defined, the hazards associated with the scope of work be identified and analyzed, a DSA be prepared, and hazard controls be established to ensure protection of workers, the public, and the environment. The DSA provides for a systematic evaluation of natural and human-made hazards, and must evaluate normal, abnormal, and accident conditions. Hazard controls would be established through technical safety requirements, which include such things as design features, administrative controls, safety and operating limits, and limiting conditions.

Based on the DSA results, the use of one of two conceptual excavation and removal operational approaches, under corrective measure Option 4 or corrective measure Option 5, would be necessary:

- Conceptual Operational Approach A, removal of the waste inventory in the open air without the need for an inert atmosphere, or
- Conceptual Operational Approach B, removal of the waste inventory in an inert atmosphere.

For either corrective measure Options 4 or 5, the DSA would specify the dimensions of a required exclusion area surrounding the shafts to protect restoration workers and equipment. In addition to the exclusion area, the dangers of fire or an explosion during shaft excavation operations could be mitigated by the use of a computer-controlled, remotely operated, tracked hydraulic excavator for removal of potentially reactive materials, such as lithium hydride, HE, and pyrophoric uranium hydride waste material, present in certain, or possibly in all, of the MDA H waste disposal shafts. The computer-controlled tracked excavator could be coupled with a hydraulic manipulator. The manipulator arm, if used, would be mounted at the distal end of the excavator boom directly behind and to the side of the excavation bucket. This configuration would allow the excavator to remotely accomplish conventional excavation operations. The versatility and dexterity of the robotic manipulator would allow management of any sensitive waste objects once they were uncovered without placing personnel in direct contact with a potential hazard. The excavator would be controlled from a remote operator console located close to the trench for Conceptual Operational Approach A or outside the exclusion zone for Conceptual Operational Approach B. Both locations would be blast-shielded as necessary. The remote operator console, if needed, would receive and transmit data to and from the system via multiple radio frequency communication channels. Multiple on-board cameras would be used to facilitate remote operations, including excavation and robot manipulation.

The decision to proceed with waste removal in an inert atmosphere would be based on the results of the DSA; it is likely that this approach would be implemented initially. Inert conditions could be established just before shaft cap removal or at the onset of cap removal. In this scenario, operations would progress using remotely operated devices to push the shaft caps aside and to remove them from the area. At this point, a remote video camera would be used for the initial internal shaft observation and inspection. Remote sampling for vapors (using a "sniffer"[22]) and moisture monitoring would be conducted at the same time to determine the composition of gases and shaft environmental conditions. The results of the initial remote shaft inspection and remote sampling would be used to determine if conditions were safe for non-remotely operated work to proceed. Conceptual Operational Approach A (open air removal) would be implemented for as long as surveillance and sampling results indicated that this method would not pose an adverse risk to worker safety. The waste removal process could continue as determined appropriate with either remote waste handlers or non-remote waste handlers.

Waste handling operations could require possible relocation of utilities, including the water line supplying Areas G and L, and temporary closure of Mesita del Buey Road and Pajarito Road during the excavation and removal of HE and DU wastes. This closure may affect routine TA-54 operations and regular traffic flow on Pajarito Road and Mesita del Buey Road. Installation of sheet piling, shoring, and blast-proofing material would be required along approximately 200 ft (60 m) of Mesita del Buey Road to protect road users and the integrity of the road structure during excavation and removal operations. Piling could be extended up to 15 ft (4.5 m) above grade for security purposes and to act as potential blast shielding during excavation and removal operations.

Conceptual Operational Approach A (Open Air)

If Conceptual Operational Approach A were implemented, one main conveyor line could extend from the MDA H shafts to an area where personnel could safely inspect and manage the excavated wastes. A conveyor system for Conceptual Operational Approach A would likely be located in the open air, but would be tented for security purposes and moisture control (even if the items removed are considered non-pyrophoric, moisture on the conveyor belt would cause potential work-related mechanical problems that could result from freezing or wet waste items). A "top pick" removal (removal of shaft contents by crane through the top of the shaft) was considered for Conceptual Operational Approach A but was dismissed in favor of removing waste laterally in 5 ft- (1.5 m-) lifts; lifting HE waste from the top could potentially result in a 60 ft- (18 m-) drop of the HE with sparking and resulting fire due to the open air atmosphere in the shaft.

Conceptual Operational Approach A could be implemented by first excavating two trenches parallel to the shafts and on both sides to a depth of 3 to 5 ft (0.9 to 1.5 m) using standard scraper and bulldozer operations to allow access to the waste in the shafts. The trenches would be located close to the shafts but would not breach the shaft or shaft contents (estimated proximity to the side of the shaft would be 18 to 24 in. (45 to 60 cm). Proximity of the scraper to the shaft could be adjusted to account for sample results and shaft contents. After the trenches were dug, the shaft area could be tented. Tenting would act as a security enclosure and would provide moisture protection for the opened shafts; moisture, especially rain, could react adversely with

[22] "Sniffers" are devices that obtain air samples for identifying hazardous vapors.

some waste materials in the disposal shafts resulting in fires or other detrimental site effects. Tenting, if used, would remain in place for moisture control and security reasons with open sides for ventilation until the shaft wastes had been completely removed.

Conceptual Operational Approach A would allow for the excavation of all nine shafts simultaneously. The waste in the shafts would be uncovered by removing the surrounding tuff in 3- to 5-ft (0.9- to 1.5-m) increments. The exposed 3 to 5 ft (0.9 to 1.5 m) of waste would then be removed as it is uncovered; then the tuff surrounding the next 3 to 5 ft (0.9 to 1.5 m) of the shaft would be removed and the next layer of waste would be uncovered and removed. Removal of the shaft waste contents would continue by systematically removing the shaft contents down to the newly created grade level, then repeating the scraper operation in 3 to 5 ft (0.9 to 1.5 m) increments in proximity to the shafts all the way to the bottom of the shafts. The tuff adjacent to the shafts would be excavated to a final depth of about 62 ft (18.6 m) below ground surface. The complete footprint of the excavation would measure about 260 ft (78 m) by 120 ft (36 m) by 62 ft (18.6 m) at the bottom of the shafts, as indicated in Figures 9 and 10.

This approach's excavation method would be the construction method of benching 5 ft (1.5 m) horizontally for every 15 to 20 ft (4.5 to 6 m) of depth. This method of excavation has been performed at other LANL excavations into mesa tops such as trenching in Area G and would allow for entrapment of surface slough and rocks, while minimizing the surface disturbance. Utilization of this method of excavation would minimize the surface disturbance. It is expected that the surface disturbance would be restricted to about 15 ft (4.5 m) on either side of the shafts; the total surface disturbance is expected to be about 290 ft (87 m) by 150 ft (45 m) as indicated in Figures 9 and 10. This method of excavation would be subject to approval from the LANL Project Engineer and would depend on the condition of the tuff at the MDA H site.

The wastes removed from the shafts would be conveyed by standard construction conveyer equipment to the sorting and declassification area and checked first for hazard (radiation level, fire, and explosion potential) then sorted for security purposes. The material requiring declassification (shapes and forms) could be shredded or crushed, as appropriate, to declassify these items as well as to reduce the waste volume.

Conceptual Operational Approach B (Inert Atmosphere)

Conceptual Operational Approach B would require the use of an inert atmosphere during waste removal from the individual disposal shafts to minimize the potential for spontaneous ignition of uranium hydride during excavation. An effectively inert atmosphere could be provided by flooding a shaft with liquid nitrogen. Liquid nitrogen would displace oxygen in the shaft so that excavation activities could be performed in an atmosphere that would inhibit spontaneous reactions of uranium hydride. A tented enclosure that would contain robotic lifting equipment would be installed over the top of the shaft. As excavation proceeded, pumping of the liquid nitrogen would be constant, but at a low level, to create a slight positive pressure within the tented enclosure. This method of operation would not necessarily maintain an oxygen-free atmosphere, but would provide an atmosphere with a low enough level of oxygen to manage the possibility of unwanted reactions with oxygen. Conceptual Operational Approach B would first be implemented with a "lower risk" shaft as identified by site disposal records to "prove out" the operation. Work would then proceed to "higher risk" shafts.

Based on the safety envelope and criteria set forth in the DSA, a remotely operated system could be designed to remove the waste through the tops of the shafts. Unlike Conceptual Operational Approach A, potential sparking and fire due to reaction of the HE with oxygen in the atmosphere would not be a concern in the inert atmosphere provided by Conceptual Operational Approach B. Shaft contents would be removed from one shaft at a time to allow for a tented enclosure over the top of the shaft being excavated. The tented enclosure would be applied over only the MDA H shaft area and the remote-handling, hydraulic telescopic arm used to remove small items (under 660 to 1,100 pounds [lb] [300 to 500 kilograms (kg)]). Protruding from the top of the tented enclosure could be a cable attached to a small crane to lift heavier items. The lift cable and crane would likely be positioned outside the tented enclosure. The crane boom would be directly over the tented enclosure to allow for removal of heavier items. There would be no internal combustion equipment operating within the tented enclosure.

Excavation would be performed by non-sparking remote handling robotics with a tool set that could include "grabbers," "sniffers," remote video, and various other sampling devices. Remotely operated telescopic arms with grabbers are rated to lift 1,000 lb (450 kg) vertically. Crane lifting would be used for greater than 1,000-lb (450-kg) lifts of individual shaft waste items. "Sniffers" would also be used onsite.

Excavated materials containing uranium hydride would be maintained under stable conditions until they could be allowed to react under controlled conditions. These items would be packaged within the inert atmosphere inspection station, as described previously, into sealed containers that would be transferred to an appropriate disposal location. Excavated items that would not be likely to pose a safety hazard could be transferred out of the inert atmosphere and into the sorting and declassification facility for disposition. For Conceptual Operational Approach B, an item would not be exposed to open air until the item had been identified and its attributes (such as radioactivity and material type) were known. Prior to direct human interface, the tools on the conveyor would be used to measure the density of the object, perform a remote video scan for identification, measure radiation levels (if any), and identify any other attributes needed for positive object identification.

Even Conceptual Operational Approach A would have the capability to move excavated material to the inert atmosphere inspection station if the material could not be positively identified at shaft side. If it became necessary to manipulate an item (for example, flip it over to verify its identity), that procedure would be performed within an inert atmosphere until any potential hazard had been identified and mitigated. It is expected that the bulk of this material would be non-hazardous and would be packaged for waste recycling (LANL 2003).

When the excavation was completed under either Conceptual Operational Approach A or Conceptual Operational Approach B conditions, soil samples would be taken and a "sniffer" would be lowered down to the bottom of the shaft to identify the presence of any residual gases, such as tritium. It is possible that a few more feet of the shaft soils and rock would be removed based on the results of testing at the bottom of the shaft. This material would be removed, classified by waste type, packaged, and disposed of according to waste classification and according to the corrective measure chosen.

Waste Management Common to Corrective Measure Options 4 and 5

Approximately 50,000 cubic yards (yd^3) (38,000 cubic meters [m^3]) of material (soil and tuff overburden) would be removed from the MDA H excavation site and transported by truck over the new access road to the overburden storage area, located within approximately 900 ft (300 m) of the excavation site (see Figure 9). The overburden material would be placed on a thick plastic liner laid over the ground's surface at the storage area to prevent any possible cross contamination with the site soil and periodically sprayed with liquid stabilizers ("tackifiers[23]") to suppress dust emission. While being stored at this location, the overburden material would be sampled and analyzed to determine whether the overburden material was contaminated. Contaminated material would be segregated and managed as appropriate.

The wastes would be sorted for classification, decontamination, recycling, and packaging for ultimate disposal at an onsite (corrective measure Option 4) or permitted offsite (corrective measure Option 5) location according to the corrective measure chosen for implementation. Potential risks to workers would be minimized by the use of appropriate PPE in areas of material sorting, declassification, characterization, and packaging. Level B respiratory protection (air supplied by either air tanks strapped to each worker or by an air line supply to workers) could be required during certain waste handling operations. Engineering controls may be substituted for the need to use of Level B respiratory protection. Any classified waste removed from MDA H could undergo a declassification review and potential object reshaping by milling, crushing, shredding, or other methods before it could be recycled or disposed. After completion of shaft excavations, the recyclable overburden material would be hauled back to MDA H and used as backfill. It is estimated these activities would result in the transport of approximately 5,000 10-yd^3 (7.6-m^3) truckloads of material back and forth over the newly constructed access road. It is projected that the majority of the overburden material would be returned to the excavation site. However, any of the overburden characterized as LLW, hazardous waste, or mixed waste (an estimated total of about 5,000 yd^3 [3,800 m^3] for these waste types) would be subject to appropriate disposal requirements. The selection of treatment or disposal locations under both corrective measure Options 4 and 5 would depend on the waste characterization results and radioactive content of the waste. Wherever practical, waste minimization techniques (such as decontamination and recycling of metal) would be applied to the removed wastes. Recycling within the DOE complex, including LANL, would be performed to the extent feasible. The estimated amount of metal from the MDA H shafts that could be recycled or disposed of in the DOE complex, including LANL, is approximately 129,000 lbs (58,050 kg).

There are about 5,000 lb (2,250 kg) of HE in the MDA H inventory. Under both corrective measure Options 4 and 5, the HE would be removed from the shafts, segregated, and packaged in billets. A 50-lb (22.5-kg) billet of HE measures about 1 ft × 1 ft × 1.5 ft (0.3 m × 0.3 m × 0.45 m). There would be about 100 (about 5.5 yd^3 [4.2 m^3]) of these billets transported to TA-16 at LANL for deactivation through flashing (burning) (TA-16 contains existing operations including burn pads used for burning residual HE materials.) After flashing, any residual ash would be sampled, analyzed to ensure that no detonable HE remains, packaged, and sent to Area G for storage and final disposition. Depending on the nature of the HE waste, there may be no ash

[23] Tackifiers are chemical dust suppressants often added to water that act to disperse the chemicals, then evaporate after application. The chemicals that are left behind bind the soil particles together into larger particles that are less easily blown in the air.

remaining after flashing. The HE waste would be transported to TA-16 at night in a vehicle used specifically for this purpose. If a decision were made to excavate HE at MDA H, then a study would be prepared on the waste quantity of HE to transport, hours of transport, safeguards and security, and other relevant considerations.

The time to design, implement, and complete corrective measure Options 4 or 5 is estimated to be approximately 48 months. Both corrective measure options would require about six months design and 40 months implementation time. Corrective measure Option 4, complete excavation with maximal offsite disposal of wastes, would cost about $51,906,000. Corrective measure Option 5, complete excavation with maximal onsite disposal, would cost about $48,602,000. These costs would be refined when a preliminary design package is completed. The design package would be based on the results of the DSA for MDA H. Although corrective measure Options 4 and 5 would be complex and expensive to implement, excavation of the materials disposed of in the MDA H shafts would result in removal of the source of contamination, thus eliminating any future potential exposure and transport of contaminants. Complete removal of all wastes from the MDA H shafts and the residual material in the surrounding tuff would impose no requirements for long-term maintenance or monitoring because, upon completion of excavation and removal activities, no wastes would remain at MDA H. The following subsections contain special features of each of the excavation and disposal corrective measure options.

At the conclusion of implementing an excavation and removal corrective measure option, the surface of the MDA H site would be restored to its original condition, as much as practicable. The existing topsoil (separate from the overburden) at the site would have been removed and stored separately for reuse on the site after backfilling was complete. The stored overburden material would be used to backfill the excavation area. The overburden material would be brought in and compacted as the hole was filled up. Additional clean soil would need to be brought onsite to backfill the excavated area. The stored topsoil would then be placed over the compacted overburden. When the excavated area had been backfilled and compacted, the site would be regraded and revegetated with native grasses and herbaceous plants. An appropriate native seed mix would be used for revegetation. The area would be watered as necessary to establish the vegetation.

2.4.2.1 Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

Corrective measure Option 4 of the Proposed Action would be to implement complete excavation of all wastes from MDA H followed by offsite disposal of the inventory of MDA H at DOE or commercially available disposal sites to the maximum extent practicable. Waste shipped offsite would be packaged to meet U.S. Department of Transportation (DOT) shipping requirements and TSD-specific waste acceptance criteria and permit conditions before shipment and disposal could occur. Most nonradioactive, hazardous wastes could be disposed of at a number of permitted commercial hazardous waste disposal facilities. However, a portion of the hazardous waste at MDA H has the potential to be radioactively contaminated mixed waste and could, therefore, be disposed of only at facilities licensed to manage mixed radioactive and hazardous waste up to an authorized limit. Several TSD facilities may be appropriate for one or more categories of waste that can be anticipated in the MDA H inventory. Whenever possible, the closest site permitted to accept a given waste type would be chosen. Some waste types could be shipped offsite from LANL to appropriately licensed commercial facilities for disposal. An above ground engineered disposal cell facility near Clive, Utah, about 826 mi (1,330 km) from LANL, is permitted to receive and treat a variety of wastes, including LLW. The Utah facility can be accessed by State and Federal highways or rail. All shipments would be made via commercial truck carriers from LANL.

All waste requiring offsite disposal would be transported via Pajarito Road. It is estimated that a total volume of about 1,500 yd^3 (1,140 m^3) of excavated material and an additional 5,000 yd^3 (3,800 m^3) of overburden material would require transportation on public roads to offsite recycle facilities or offsite disposal sites. A total of 187,000 lbs (84,150 kg) of LLW DU and an additional 94,000 lbs (42,300 kg) of LLW of other radionuclides could be shipped offsite from LANL for disposal at the Nevada Test Site (NTS) or an appropriately licensed commercial facility such as the above ground engineered disposal cell facility near Clive, Utah. A portion of the lithium compounds, plastics, and graphite (an estimated total of 74,000 lbs [33,300 kg]) could be hazardous waste and may require disposal offsite in a hazardous waste permitted disposal unit.

2.4.2.2 Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Corrective measure Option 5 of the Proposed Action would be the complete excavation of waste at MDA H followed by the disposal of LLW at Area G within LANL's TA-54 to the maximum extent practicable and the disposal of hazardous waste at an offsite DOE or permitted commercial RCRA-regulated landfill. The excavation of waste would be the same as that described for corrective measure Option 4. Disposal, however, would be split between LLW disposal at Area G and offsite disposal of RCRA-regulated wastes. A total of 187,000 lbs (84,150 kg) of LLW DU, an additional 94,000 lbs (42,300 kg) of LLW of other radionuclides, and about 5,000 yd^3 (3,800 m^3) of overburden waste could be disposed of at Area G.

Corrective measure Option 5 would also include treatment of hazardous and mixed wastes onsite at LANL. It is expected that the hazardous wastes present in the MDA H shafts would be only characteristic hazardous waste or hazardous waste based on the RCRA characteristics of ignitability, corrosivity, reactivity, and toxicity. Additionally, it is expected that this hazardous waste could be defined as "debris"[24] under RCRA. As such, mixed wastes meeting the definition of debris could be treated onsite under this approach to remove the RCRA hazardous characteristic. After treatment, it is expected that these wastes would meet RCRA land disposal restriction treatment standards and would no longer be subject to management and disposal as hazardous waste under RCRA. Therefore, disposal at a RCRA-regulated disposal unit may not be required. After treatment, the formerly mixed wastes could then be managed as LLW and disposed of at Area G. For example, HE-contaminated DU wastes would be sent to TA-16 to be "flashed," and then sent to Area G for disposal. Nonhazardous DU wastes would go directly to Area G. Residuals could be disposed of as LLW or as nonhazardous solid waste, as appropriate. Hazardous wastes could be treated to meet RCRA land disposal restrictions by removing the hazardous characteristics and subsequently disposed of as LLW at Area G. It is not expected that any radioactive waste would be sent offsite for treatment before disposal.

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[24] Debris is defined as solid material exceeding a 2.4 in. (60 millimeters [mm]) particle size that is intended for disposal and that is a manufactured object; or plant or animal matter; or natural geologic material (40 CFR 268).

Some reactive wastes, such as lithium hydride and HE (discussed previously), could be deactivated so that there would be no regulated hazardous residuals requiring disposal. There are about 4,340 lb (1,953 kg) of lithium hydride in the MDA H waste inventory. Lithium hydride could be reacted in controlled conditions with water to form hydrogen gas and dilute lithium hydroxide, which could be discharged to the LANL sanitary wastewater treatment system. Although this lithium hydride treatment capability does not currently exist at LANL, a portable unit could be brought onsite as part of the corrective measure implementation. A portion of the lithium compounds, plastics, and graphite (an estimated total of 74,000 lbs [33,300 kg]) could be hazardous waste and may require disposal offsite in a hazardous waste permitted disposal unit, unless treatment at LANL is successful in removing the hazardous waste characteristics.

2.5 Alternatives Considered but Dismissed

Other options were considered in the CMS Plan (LANL 2001b) and the CMS Report (LANL 2003) but were eliminated based on site conditions, waste characteristics, or technical feasibility. UC staff at LANL evaluated 26 candidate corrective measure technologies potentially appropriate to MDA H site conditions and waste types (Figure 12 [1], [2], and [3]). These technologies fall into four general categories:

- Containment (surface and subsurface barriers),
- Treatment in place (biological and physical treatments used to reduce the mobility or toxicity of wastes, or to increase their stability without removing the wastes from their disposal location),
- Excavation and removal (vertical shaft excavation or trench excavation), and
- Excavation and treatment (neutralization, thermal treatment, cement stabilization, and debris removal).

Of the 26 technologies evaluated, 13 were eliminated. Technologies retained (designated "potentially applicable technologies" in column 5 of Figure 12) after the screening evaluation were combined into preliminary corrective measure options. RCRA guidance and Module VIII of the LANL's Hazardous Waste Facility Permit require that corrective measure options be developed based on site conditions (including contaminant inventory), design of the disposal units, environmental setting, corrective measure objectives, and the viability of the corrective measure technologies. Based on these five criteria, corrective measure options were developed and presented in the MDA H CMS Plan (LANL 2001b) and the CMS Report (LANL 2003), and are thus analyzed in this EA.

The eliminated technologies either are not feasible to implement, or rely on technologies that would be unlikely to perform satisfactorily, or would not achieve the desired result within a reasonable timeframe. The corrective measure options that were eliminated from further consideration were not considered reasonable alternatives to meet the DOE's stated purpose and need for action and are not carried through the analysis provided in this EA.

2.6 Related Actions

2.6.1 Final Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory (SWEIS)

The Final LANL SWEIS (DOE 1999a) was issued early in 1999. A Record of Decision (ROD) (DOE 1999b) was issued in September 1999, and a Mitigation Action Plan was issued in October 1999 (DOE 1999c). The SWEIS explained that environmental restoration at LANL was being performed by a LANL organization established by DOE in 1989 to assess and remediate potentially contaminated sites that either were or still are under LANL control. In addition, the SWEIS (p. 2-9) includes the information that in 1996, the DOE Office of Environmental Management (EM) initiated a complex-wide strategy to accelerate site cleanup and enhance performance of the cleanup program. Known as *Accelerating Cleanup: Paths to Closure* Report (DOE 1998) (previously known as "2006 Plan"), it includes input from all major field sites, including LANL, to support EM's program planning process.

The SWEIS (5-78) (vol. III, app. F, section F.6.6) included an analysis of impacts for specific waste management operations and transportation impacts of the various SWEIS alternatives at levels that were greater than are currently being forecast as needed in the foreseeable future. The analysis of these five corrective measure options considered in this EA is therefore bounded by the analysis of LANL operations in the SWEIS. This EA tiers from the SWEIS and a reanalysis of LANL operations per se will not be provided in this EA. Any points of difference from the effects attributed to the remediation of MDA H will, however, be included in the Section 4 analysis of effects within this EA.

2.6.2 Final Waste Management Programmatic Environmental Impact Statement (WM PEIS)

The WM PEIS (DOE 1997), issued in May 1997, studied the potential nation-wide impacts of managing four types of radioactive waste (LLW, mixed LLW, TRU, and high-level radioactive waste[25]) and hazardous waste generated by defense and research activities at 54 sites around the United States. The ROD for the treatment and disposal of LLW and mixed LLW was issued on February 25, 2000 (65 FR 10061), and the ROD for the treatment of non-wastewater hazardous waste was issued on August 5, 1998 (63 FR 41810). The WM PEIS includes preferred alternatives for locations of treatment, storage, and disposal of each of the waste types analyzed. DOE uses the WM PEIS in deciding how to configure needed treatment, storage, and disposal, depending on waste type.

[25] High-level radioactive waste is the highly radioactive waste resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from the liquid waste that contains fission products in sufficient concentrations, and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation (DOE Order 435).

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3.0 Affected Environment

Section 3.0 describes the natural and human environment that could be affected by implementing the Proposed Action and the No Action Alternative. Based on the Proposed Action description, environmental resources that may potentially be affected as a result of implementing the Proposed Action have been considered. Environmental issues were identified and either addressed in this section or not, based on the "Sliding Scale Approach" discussed earlier in this EA (Section 1.4). Table 2 identifies the subsection where potential environmental issues are discussed or notes why they are not addressed in this document.

Table 2. Potential Environmental Issues Applicable to this EA

Environmental Category	Applicability	Subsection
Environmental Restoration and Waste Management	Yes	3.2
Water Resources (Surface and Ground)	Yes	3.3
Climatology and Air Quality	Yes	3.4
Geology	Yes	3.5
Human Health	Yes	3.6
Transportation and Utilities	Yes	3.7
Noise	Yes	3.8
Environmental Justice	Yes	3.9
Socioeconomic	Yes	3.10
Land Use	No. None of the Proposed Action corrective measure options would change the land use at TA-54 to a designation other than Waste Management.	N/A
Floodplains and Wetlands	No. The Proposed Action would not be located in a floodplain or wetland.	N/A
Cultural Resources	No. Field surveys and onsite inspection by trained archaeologists reveal that there are no cultural resources within the vicinity of MDA H.	N/A
Visual Resources	No. All corrective measure options involve only local construction in an existing industrial area. Interim storage of about 50,000 yd^3 (38,000 m^3) of overburden would result in a temporary mound of soil and tuff about 60 ft (18 m) high within TA-54. This overburden would be returned to the MDA H work site to be used as backfill.	N/A
Biological Resources	No. The Proposed Action would be located within previously disturbed and developed land or adjacent to disturbed areas within an industrialized area of LANL. The Proposed Action site is adequately distant from potential habitat for sensitive wildlife and plants.	N/A

3.1 Regional Setting

The Proposed Action would be located within the area of Los Alamos County that includes LANL. LANL comprises a large portion of Los Alamos County and extends into Santa Fe County. LANL is situated on the Pajarito Plateau along the eastern flank of the Jemez Mountains and consists of 49 technical areas. The Pajarito Plateau slopes downward towards the Rio Grande along the eastern edge of LANL and contains several fingerlike mesa tops separated by relatively narrow and deep canyons.

Commercial and residential development in Los Alamos County is confined primarily to several mesa tops lying north of the core LANL development, in the case of the Los Alamos town site, or southeast, in the case of the community of White Rock. The lands surrounding Los Alamos County are largely undeveloped wooded areas that are administered by the U.S. Department of Agriculture, Santa Fe National Forest; the U.S. Department of the Interior, National Park Service, Bandelier National Monument; the U.S. Department of the Interior, Bureau of Land Management; and San Ildefonso Pueblo.

3.2 Environmental Restoration and Waste Management

DOE and UC staff at LANL are jointly responsible for implementing the environmental restoration activities at LANL, which is a permitted RCRA hazardous waste facility. Environmental Restoration at LANL is governed primarily by the corrective action process prescribed in RCRA, but is also subject to other applicable laws, regulations, DOE orders, and LANL policies. The NMED administers RCRA in New Mexico. DOE, NNSA, through the Los Alamos Site Office, oversees site characterization and waste cleanup and remediation activities at LANL PRSs.

PRSs include SWMUs[26] and areas of concern,[27] collectively. PRSs at LANL include septic tanks and lines, chemical storage areas, wastewater outfalls (the area below a pipe that drains wastewater), landfills, firing ranges and their impact areas, surface spills, and electric transformers. PRSs are found on mesa tops, on canyon walls, and in canyon bottoms. The main pathways by which released contaminants can migrate are infiltration into alluvial aquifers, airborne dispersion of dust or particulate matter (PM), and migration from surface runoff. The environmental contaminants at LANL include VOCs, semivolatile organic compounds, polychlorinated biphenyls, pesticides, heavy metals, radionuclides, petroleum products, and HE. The 1999 LANL SWEIS (DOE 1999a) contains additional information on LANL contaminants. The Proposed Action would involve MDA H, which is designated as SWMU 54-004 within TA-54.

UC staff at LANL generate solid waste from construction, demolition, and facility operations. These wastes are managed and disposed of at appropriate solid waste facilities. Both LANL and Los Alamos County currently use the same solid waste landfill located within LANL boundaries on DOE-administered land. The Los Alamos County Landfill receives about 50,000 tons of solid waste per year (45,500 metric tons per year), with LANL contributing about 10,500 tons per year (9,555 metric tons per year), or about 21 percent of the total. When the current Los Alamos County Landfill closes, currently estimated to occur in 2007, it would be capped and monitored. NNSA and UC staff at LANL are currently investigating future waste management options for LANL solid waste.

[26] A SWMU is defined in the HSWA Module VIII of LANL's Hazardous Waste Facility Permit as "any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at or around a facility at which solid wastes have been routinely and systematically released."

[27] Areas of concern are PRSs that may warrant investigation or remediation, but do not meet the definition of a SWMU.

Building-debris storage yards on Sigma Mesa, the Los Alamos County Landfill, or other approved material management areas at LANL are currently used to store concrete rubble, asphalt, and clean soil for future re-use at LANL or for recycling offsite. Management of all waste at LANL is carried out in accordance with applicable laws, regulations, and DOE orders. LLW, including DU, is disposed of at TA-54, Area G. HE debris material is burned at TA-16. Hazardous waste regulated under RCRA is transported to Area G at LANL for proper management. Hazardous wastes and mixed wastes may be treated onsite or offsite but must be disposed of offsite since LANL has no permitted onsite disposal facilities for these waste types. The offsite disposal locations are located across the U.S. and are audited for regulatory compliance before being used for LANL hazardous or mixed waste disposals.

Waste shipped offsite from LANL for disposal must meet stringent DOT shipping requirements and TSD-specific waste acceptance criteria and permit conditions before transportation occurs. Most nonradioactive, hazardous wastes can be disposed of at a number of permitted hazardous waste disposal facilities. Some hazardous wastes may be radioactively contaminated; these are referred to as mixed waste. This waste type can only be disposed of away from LANL at offsite locations that are licensed to manage mixed radioactive or hazardous waste up to an authorized limit. Several TSD facilities are appropriate for one or more categories of waste generated by LANL operations and the LANL environmental restoration activities. These disposal facilities currently include DOE's NTS and commercial firms located in Washington or Utah.

The Secretarial Memorandum on release of materials from DOE facilities (Richardson 2000) states that recyclable metals must remain within the DOE system and cannot be sent to commercial metal recyclers. Nonhazardous, nonradioactive metals may be recycled through the LANL-operated recycling facility when its acceptance criteria are met.

The following metals are suitable for recycling within the DOE system by metal melting even if they are radioactively contaminated: stainless steel, carbon steel, iron, galvanized metal, nickel alloys, chromium alloys, and ferrous alloys. This process is also suitable for small quantities of copper, aluminum, brass, and bronze. The following metals are suitable for recycling within the DOE system following decontamination: lead, stainless steel, carbon steel, iron, copper, aluminum, nickel, chromium, galvanized metal, and brass.

3.3 Water Resources (Surface and Ground)

Surface water at LANL occurs primarily as short-lived or intermittent reaches of streams. Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the volume is insufficient to maintain surface flows across LANL. Runoff from heavy thunderstorms or heavy snowmelt can reach the Rio Grande. Effluents from sanitary sewage, industrial water treatment plants, and cooling tower blow-down enter some canyons at rates sufficient to maintain surface flows for varying distances (DOE 1999a). Surface waters at LANL are monitored by LANL and the NMED. Planned releases from industrial and sanitary wastewater facilities within LANL boundaries are permitted under NPDES stormwater permits. Construction, maintenance, or other intrusive activities conducted within water courses are carried out under the *Clean Water Act* Sections 401 and 404 as implemented by the NMED for the State of New Mexico and the Army Corps of Engineers, respectively. The application of BMPs to mitigate impacts from stormwater runoff is required under LANL's NPDES Multi-sector General Permit for stormwater discharges.

The nature and extent of groundwater within the LANL region have not been fully characterized. Current data indicate that groundwater occurs near the surface in the canyon bottom alluvium, perched at deeper (intermediate) levels below the alluvium, and at still deeper levels in the regional aquifer (LANL 1995a). Alluvial groundwater has been identified primarily through monitoring wells drilled around LANL (DOE 1999a). Within LANL boundaries, continually saturated alluvial groundwater occurs in Mortandad, Los Alamos, Pueblo, Sandia, and Pajarito Canyons. The depth to perched groundwater varies from about 90 ft (27 m) in the middle of Pueblo Canyon to about 450 ft (135 m) below the ground surface in lower Sandia Canyon (LANL 1993). Based on data from wells and boreholes in and around TA-54, perched groundwater is not known to exist beneath the immediate MDA H area. The regional aquifer is separated from the alluvial groundwater by 350 to 620 ft (105 to 186 m) of unsaturated volcanic tuff and sediments (LANL 1995b). At MDA H, the estimated depth to the regional aquifer is 1,040 ft (312 m) (LANL 2001c). Recharge of the regional aquifer is not fully understood nor characterized but is not expected to be strongly interconnected across its extent. Groundwater within the LANL area is monitored to provide indications of the potential for human and environmental exposure from contaminants (DOE 1999a). Groundwater protection and monitoring requirements are included in DOE Order 450.1, Environmental Protection Program.

There have been subsurface releases of VOC vapors and tritium in the form of water vapor from MDA H. Transport of tritium through the subsurface would be expected to be in the form of water vapor associated with residual moisture within the tuff. The thickness of the unsaturated rock between the tritium source in the disposal shafts and the regional aquifer is 1,040 ft (312 m). The current measured moisture content of the Bandelier tuff is less than 5 percent (LANL 2001d). Under this existing moisture content, water within the unsaturated rock on Mesita del Buey would not be expected to recharge into the regional aquifer for thousands of years, if at all. Evidence supporting this statement includes natural tracer studies, pore-water chemical analyses, moisture-measurement analyses, and groundwater flow calculations (LANL 1997a).

Analytical results from the RFI (LANL 2001a) were used to assess the present-day impacts to ecological and human receptors. The present-day risk assessment concluded that existing soil contamination does not exceed applicable EPA and NMED risk thresholds. The tritium inventory in the disposal shafts has already been reduced by diffusion and by radioactive decay. Tritium has a short half-life of about 12.3 years. Since it was disposed of, the tritium inventory in the shafts has been reduced by a factor of 2 every 12.3 years and will continue to diffuse at a slower and slower rate.

Data and analysis of LANL surface and groundwater samples indicate that LANL operations and activities have affected the surface water within LANL boundaries and some of the alluvial perched groundwater zones in the LANL region as well. Details on the surface and groundwater quality can be found in the annual LANL Environmental Surveillance and Compliance Report (LANL 2002b).

The average precipitation rate for the area near MDA H is 14 in. (35.6 cm) per year (LANL 1990b). Most of this precipitation is lost to runoff and ET, resulting in a heterogeneous infiltration pattern that is controlled by the mesa and canyon setting of the site. Infiltration is thought to be seasonal with most occurring during spring snowmelt and, to a lesser extent, during the summer thunderstorm season (LANL 1997b).

Measured rock saturations and chloride data indicate low net percolation rates (0 to 0.2 in. [0 to 0.5 cm] per year) within the mesa (LANL 2001e, 1996). Cañada del Buey is dry with a percolation rate similar to the mesa top, while Pajarito Canyon is wetter than Mesita del Buey and Cañada del Buey with an estimated percolation rate of 0.4 to 12 in. (1 to 30 cm) per year. The small drainages surrounding the site are also expected to have percolation rates similar to the mesa top because they have small catchment areas and also are quite steep in some areas. The coupling of the fractured units separated by the high-permeability surge bed with the mesa's topographic relief is thought to enhance air circulation and consequently evaporative drying within the mesa interior. Matrix flow is expected to dominate in the unsaturated tuff units at the site. Because wastes were mostly disposed of at MDA H in large metal pieces, major contaminant transport through the unsaturated tuff units from fluid fracture flow is unlikely.

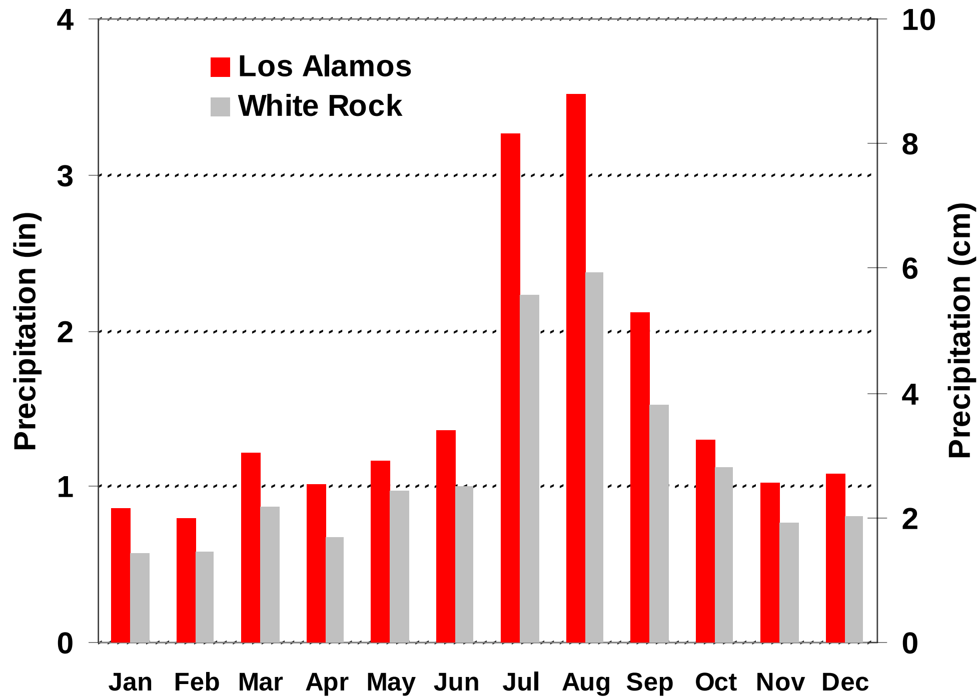
3.4 Climatology and Air Quality

Los Alamos County has a semiarid, temperate mountain climate. Annual precipitation averages 18.7 in. (46.8 cm) per year; 36 percent to 40 percent of which occurs during the summer "monsoon" season of July and August (Figure 13). However, the annual total precipitation fluctuates considerably from year to year; the standard deviation of these fluctuations is 4.8 in. (12 cm). The lowest recorded annual precipitation is 6.8 in. (17.0 cm), and the highest is 30.3 in. (75.8 cm). The maximum precipitation recorded for a 24-hour period is 3.5 in. (8.8 cm). The maximum 15-min precipitation in the record is 0.9 in. (2.25 cm). Monthly average values for relative humidity vary little during the year. Relative humidity ranges from a low of 39 percent in June to a high of 56 percent in December, averaging 51 percent over the entire year. Fog in Los Alamos is very rare, occurring less than five times per year on average.

Summers are generally sunny with moderately warm days (maximum temperatures usually below 90 degrees Fahrenheit [°F] [32 degrees Celsius (°C)] and cool nights (temperatures in the 50s°F [10s°C]). Summer thunderstorms generally occur during the afternoon or early evening. These thunderstorms are usually short, intense events that can cause significant surface water runoff. Lightning is very frequent in Los Alamos. In an average year, Los Alamos experiences 61 thunderstorm days, about twice the national average. (A thunderstorm day is defined as a day on which thunder is heard or a thunderstorm occurs.) Only in the southeastern part of the country is this frequency exceeded. In addition to lightning, hail often accompanies these summertime convective storms. Hailstones of 0.25 in. (0.6 cm) are common, but stones of 1 in. (2.50 cm) have been reported. Hail has caused significant damage to property and vegetation, and localized accumulations of 3 in. (7.6 cm) have been observed (LANL 1992a).

Winter temperatures typically range from 15 to 25°F (-9 to -4°C) during the night and warm to 30 to 50°F (-1 to 10°C) during the day. Occasionally, temperatures drop to below 0°F (-18°C) (Figure 13). Winter snow accumulation averages 51 to 59 in. (127.5 to 147.5 cm) per year. Freezing rain is rare.

Surface winds average 5.5 miles per hour (mph) (8.85 kilometers per hour [kph]) at Los Alamos. Wind speeds are strongest from March through June (averaging 8.8 mph [14.2 kph]) and weakest in December and January. Sustained winds exceeding 25 mph (40.3 kph) are common during the spring. The strongest winds are generally southwesterly through northwesterly and occur in the afternoon and evening. The complex surface terrain in the area contributes to wind



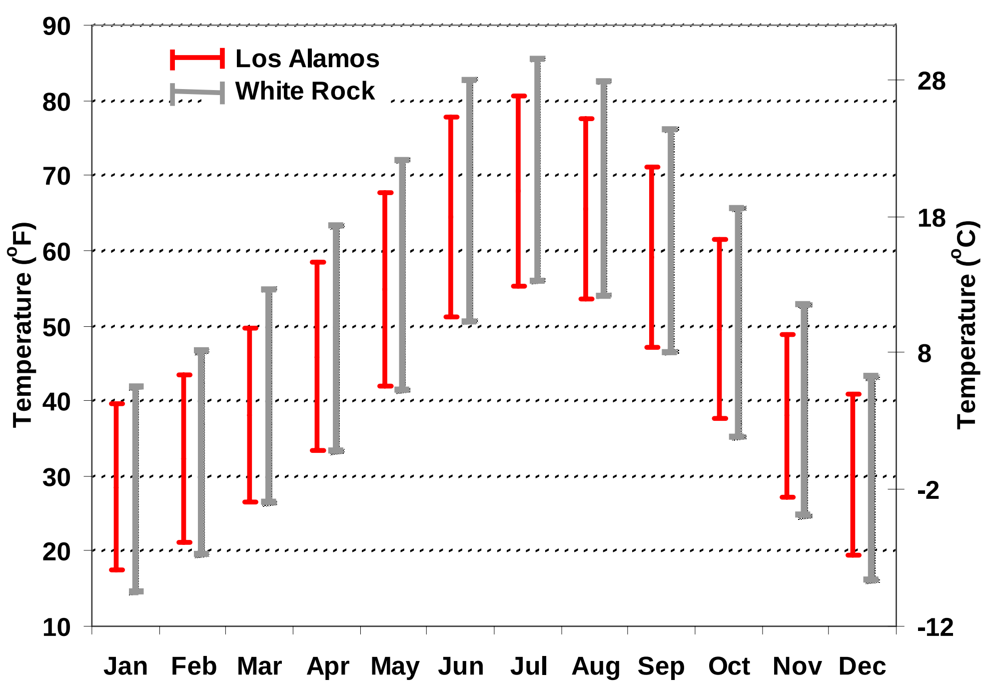


Figure 13. Mean monthly precipitation and air temperature in Los Alamos and White Rock (LANL 1990b).

conditions that vary with location and time of day. No tornadoes have been reported but strong "dust devils" (up to 75 mph) and spring wind gusts (up to 60 mph) do occur (LANL 1992a).

Average annual precipitation at a weather station within Area G on Mesita del Buey in TA-54 is about 14 in. (35.6 cm); about 40 percent of this occurs as brief, intense thunderstorms during July and August. Snowfall is greatest from December through March; heavy snowfall is infrequent during other months. Surface water runoff can occur during summer thunderstorms, frontal storms, and snowmelt periods, but the majority of runoff and resultant erosion probably occurs during the summer thunderstorm period. The canyon-mesa topography at TA-54 affects wind speed and direction in a dramatic way, as indicated by measurements taken at meteorological stations on Mesita del Buey and within Cañada del Buey and Pajarito Canyon. Comparisons of average annual wind roses from the mesa-top and canyon meteorological towers reveal the channeling effect of the mesa-canyon topography. Mesa-top winds flow predominantly south to southwest during the day. Canyon winds are strongly channeled; they flow predominantly up canyon (north-northwest) during the day and down canyon (south-southeast) and across the mesa (east) at night.

Plants adapted to this environment are very efficient in their ability to extract moisture that infiltrates into the ground, and transpiration rates (removal of water from the near-surface via root uptake and redistribution to the atmosphere through plant leaves and stems) are high. For example, at TA-54, measured average transpiration equaled the measured annual average precipitation (14 in.) over a 10-year period (LANL 1995a).

Low precipitation and high ET rates minimize the quantity of water that percolates through the vadose zone across the Pajarito Plateau, especially on mesa tops, including Mesita del Buey. The mesa geometry also enhances exposure of the subsurface to evaporative processes such as high solar radiation, strong winds, and engineered air circulation.

The *Clean Air Act* (CAA) (40 CFR 50) establishes air quality standards to protect public health and the environment from the harmful effects of air pollution. The CAA requires establishment of national standards of performance for new stationary sources of emissions, limitations for any new or modified structure that emits or may emit an air pollutant, and standards for emission of hazardous air pollutants (HAPs). In addition, the CAA requires that specific emission increases be evaluated to prevent a significant deterioration in air quality.

The EPA is the regulating authority for the CAA. However, EPA has granted the NMED primacy for regulating air quality under an approved State Implementation Plan (SIP)[28]. In New Mexico, all of the CAA regulations, with the exception of the National Emission Standards for Hazardous Air Pollutants (NESHAP) for radionuclides (40 CFR 61), certain provisions relating to Stratospheric Ozone Protection (40 CFR 82), and the Risk Management Program (40 CFR 68) have been adopted by the State as part of the SIP, and are regulated under the *New Mexico Air Quality Control Act*.

The New Mexico Environmental Improvement Board, as provided by the *New Mexico Air Quality Control Act*, has promulgated a series of air quality control regulations in the NMAC.

[28] The purpose of the SIP is to ensure that Federal emission standards are being implemented and the NAAQS are being achieved.

These regulations are administered by NMED. Under the Federal CAA and the SIP, LANL is subject to Federal air quality regulations, including those that are not part of the SIP, and all work is performed at LANL in accordance with Federal, State, DOE, LANL, and local regulations, as required. In addition to the existing Federal programs, the 1990 amendments to the CAA mandate new program requirements that include control technology for HAPs, engineered monitoring, prevention of accidental releases, and chlorofluorocarbon replacement.

Los Alamos County is in attainment with all State ambient air[29] quality standards and NAAQS. Air quality is a measure of the amount and distribution of potentially harmful pollutants in ambient air. Air surveillance at Los Alamos includes monitoring emissions to determine the air quality effects of LANL operations. LANL staff calculates annual actual LANL emissions of regulated air pollutants and reports the results annually to the NMED. The ambient air quality in and around LANL meets all State, EPA, and DOE standards for protecting the public and workers (LANL 2001c).

LANL is adjacent to Bandelier National Monument, which is a Federal Class I area designated under the CAA. Prevailing winds generally are from the south and west, but the topography of the Pajarito Plateau causes daily, seasonal, and localized changes in wind speeds and direction.

Mobile sources, such as automobiles and construction vehicles, are additional sources of air emissions; however, mobile sources are not regulated by NMED. Diesel emissions from conveyance vehicles are not regulated as stationary sources of emissions. Mechanical equipment including bulldozers, excavators, backhoes, cranes, tamper compactors, trenchers, and drill rigs are exempt from permitting under Title 20 of the NMAC Part 2.72, *Construction Permits*. This type of exemption does not require notification to NMED.

Both EPA and NMED regulate nonradioactive air emissions. NMED does not regulate dust from excavation or construction, but LANL workers take appropriate steps during construction activities to control fugitive dust and particulate emissions using, for example, best achievable control measures of water sprays or soil tackifiers. Excavation and construction activities are not considered stationary sources of regulated air pollutants under the New Mexico air quality requirements; these activities are not subject to permitting under 20 NMAC, Parts 2.70 and 2.72. Annual dust emissions from daily windblown dust are generally higher than short-term construction-related dust emissions.

3.5 Geology

The Jemez Mountains volcanic field (JMVF) is located in northern New Mexico at the intersection of the western margin of the Rio Grande Rift and the Jemez Lineament (Figure 14) (Gardner et al. 1986, Heiken et al. 1996). The Jemez Lineament is a northeast-southwest-trending alignment of young volcanic fields ranging from the Springerville volcanic field in east-central Arizona to the Raton volcanic field of northeastern New Mexico (Heiken et al. 1996). The JMVF is the largest volcanic center along this lineament (LANL 1992b). Volcanism in the

[29] Ambient air is defined in 40 CFR 50.1 as "that portion of the atmosphere external to buildings, to which the public has access." It is defined in the NMAC Title 20, chapter 2, part 72, as "the outdoor atmosphere, but does not include the area entirely within the boundaries of the industrial or manufacturing property within which the air contaminants are or may be emitted and public access is restricted within such boundaries."

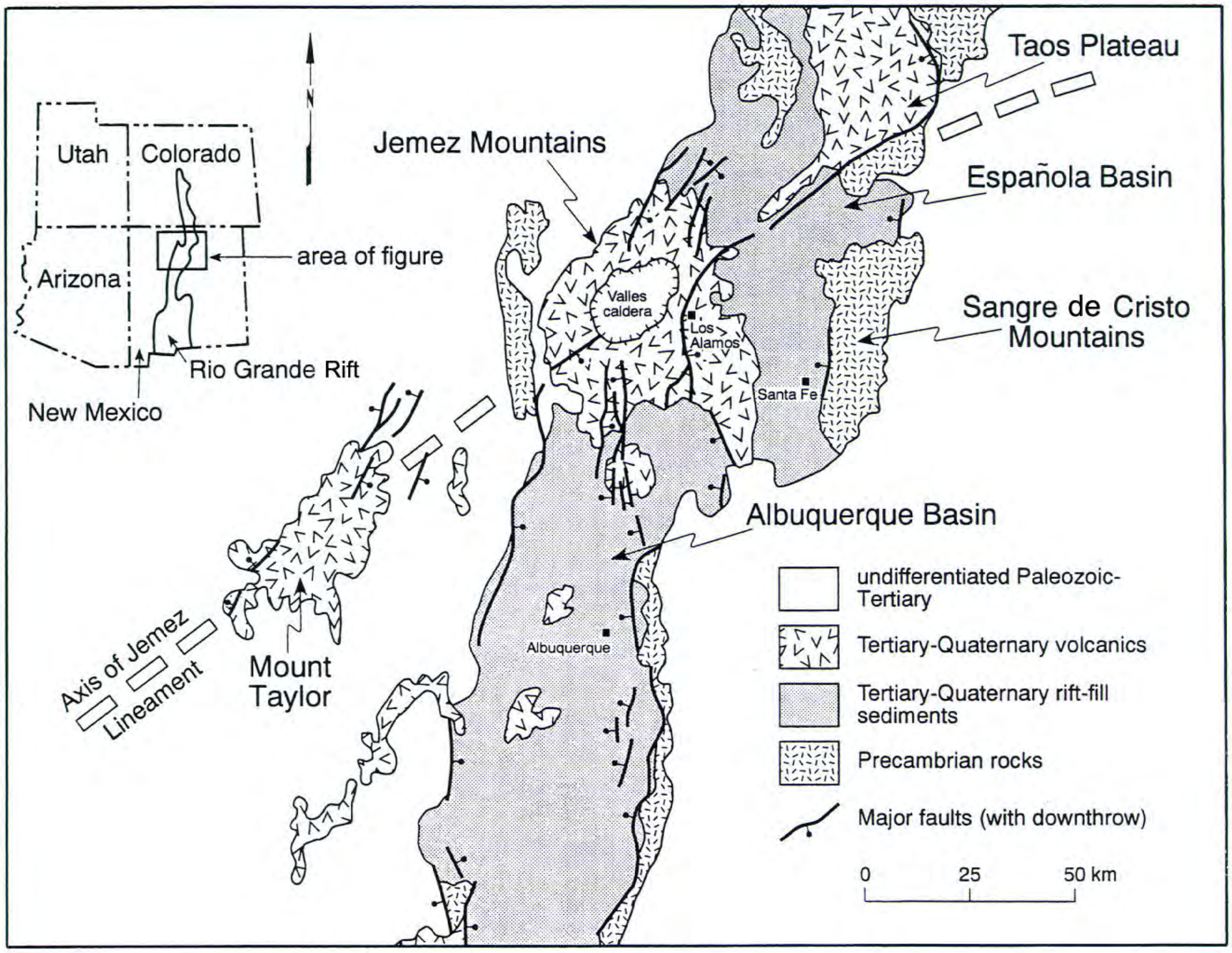


Figure 14. Generalized geologic map of the Rio Grande Rift in northern New Mexico (Self and Sykes 1996).

JMVF spans a roughly 16-million-year period beginning with the eruptions of numerous basaltic lava flows. Various other eruptions of basaltic, rhyolitic, and intermediate composition lavas and ash flows occurred sporadically during the next 15 million years with volcanic activity culminating in the eruption of the rhyolitic Bandelier Tuff at 1.79 and 1.23 million years ago (Self and Sykes 1996). All of LANL property is within the JMVF and is sited along the western edge of the Rio Grande Rift. Most of the bedrock on LANL property is composed of the salmon-colored Bandelier Tuff (Figure 15).

The geologic structure of the LANL area is dominated by the north-trending Pajarito Fault system. The Pajarito Fault system forms the western structural boundary of the Rio Grande Rift, along the western edge of the Española Basin, and the eastern edge of the JMVF. The Pajarito Fault system consists of three major fault zones (Pajarito, Guaje Mountain, and Rendija Canyon) and numerous secondary faults with vertical displacements ranging from 80 to 400 ft (24 to 120 m). Estimates of the timing of the most recent surface rupturing paleoearthquakes along this fault range from 3,000 to 24,000 years ago (LANL 2001f, 1999a). Results of seismic hazards studies (LANL 2001f, 1999a, Wong et al. 1995) indicate the Pajarito Fault system represents the

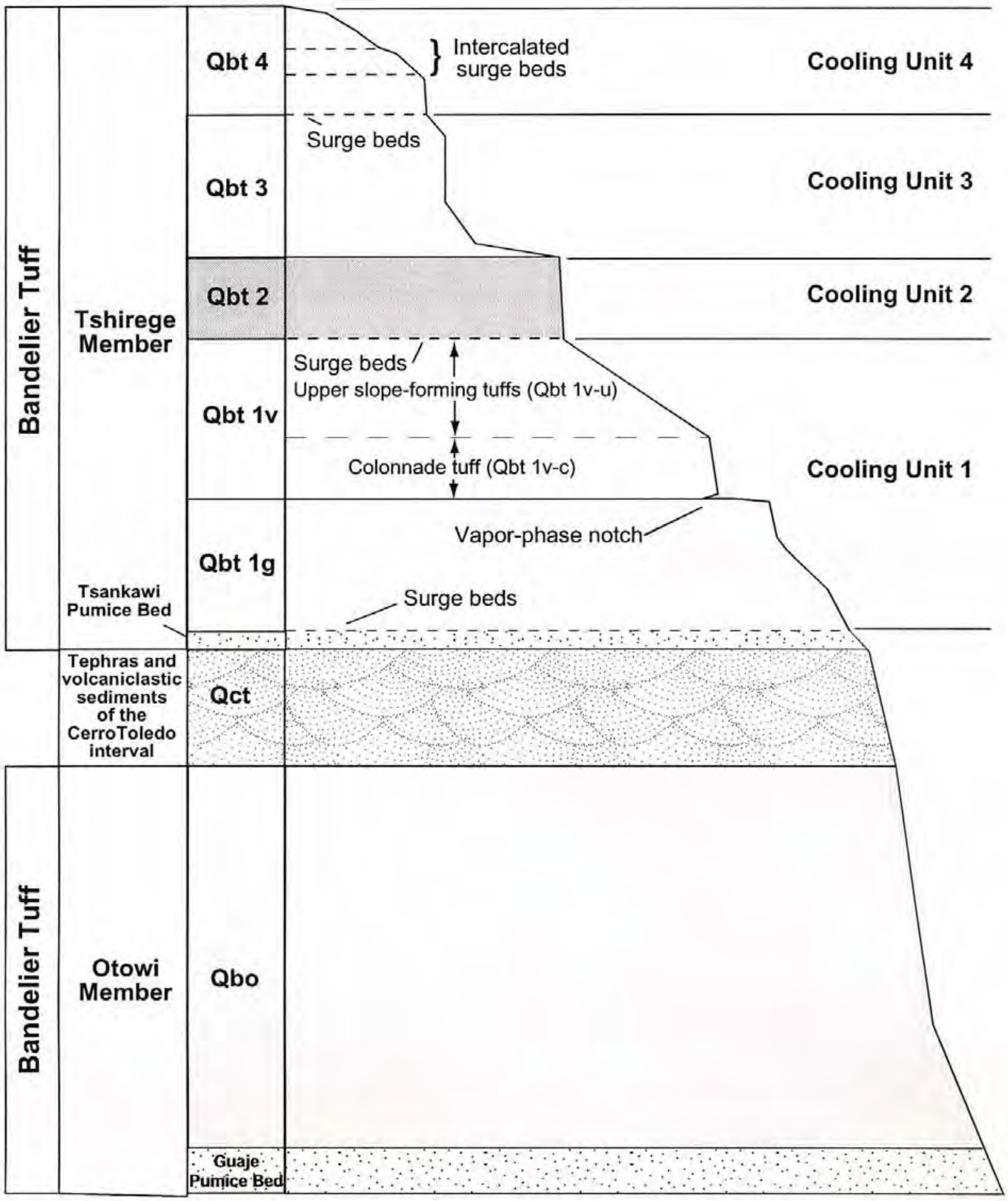


Figure 15. Stratigraphy of the Bandelier Tuff (LANL 1995a).

greatest potential seismic risk to LANL, with an estimated maximum earthquake magnitude of about 7 on the Richter Scale. Although large uncertainties exist, an earthquake with a Richter magnitude of 6 is estimated to occur once every 4,000 years; an earthquake of magnitude 7 is estimated to occur once every 100,000 years (DOE 1999a).

TA-54 has been constructed within the upper member of the Bandelier Tuff known as the Tshirege Member. The Tshirege Member erupted 1.23 million years ago during the Quaternary Period. It consists of four "cooling units" of varying thickness (see Figure 14). Each "cooling unit" represents a separate, but closely spaced in time, eruption(s) of ash that came to rest and then cooled as a unit and lithified into rock. The contact between units 1v and 2 is marked by discontinuous surge beds which have been utilized as marker beds in detailed geologic mapping of the area (LANL 1998b). The Tshirege Member of the Bandelier Tuff is characterized by numerous fractures (cracks related to cooling and contraction of the ash) and variable degrees of welding. Welding is a term that indicates the hardness of tuff. Poorly welded tuffs are very friable and weather easily. Strongly or densely welded tuffs are very hard, dense volcanic rocks that resist weathering and usually form cliffs. Unit 2 is exposed at the surface of some areas of TA-54 and is a variably welded cliff-former. The lower part of this unit is gradational into the underlying unit 1v. The amount of welding of the units generally increases upwards from non-welded at the base of unit 1g, to densely welded at the top of unit 2 (see Figure 14). In general, the rock is less dense and more friable at the base of Pajarito Canyon and becomes more dense about halfway up the Pajarito Canyon wall near TA-54.

The stratigraphy beneath MDA H is based on RFI boreholes located near MDA H and geologic information from regional well R-20 located about 0.5 mi (0.8 km) southeast of MDA H in Pajarito Canyon. The most important geologic characteristics of the rock layers beneath MDA H are those that affect the hydrology (or movement of water) beneath the site by effectively minimizing the rate of percolation of infiltrating moisture. These characteristics include a) porosity between about 45 percent and 50 percent, which under unsaturated conditions creates a capillary suction that holds liquid water; and b) discontinuous open fractures in the more welded units, which under unsaturated conditions enhance the evaporation of moisture from deep within the subsurface (LANL 1997c).

There are 37 known faults within the TA-54 area from Area G to Area J (LANL 1998b). These are minor secondary faults with 2 to 26 in. (5 to 65 cm) of displacement. The general absence of larger-scale offsets or inflections along the contact between units 2 and 1v within this area indicates these faults are not associated with major fault zones. These faults are not concentrated in discrete zones and may represent widespread distributed secondary faulting associated with earthquakes that occurred along the main trace of the Pajarito Fault. There is, however, a 500- to 833-ft- (150- to 250-m-) wide zone of greater magnitude faulting present roughly 0.6 mi (1 km) east of TA-54 with faults displaying offset of 5 to 11.7 ft (1.5 to 3.5 m) (LANL 1998b). The significance of this fault zone is not currently understood.

A seismic hazard evaluation was conducted at several sites around LANL to estimate ground motion from possible earthquakes (tectonics) (Wong et al. 1995). The evaluation led to the following conclusion: within 100 years, an earthquake with a magnitude of 6 or greater is considered likely to occur in the Pajarito Fault system. While TA-54, including MDA H, was not included in the study, the geology at TA-54 is similar to two of the sites evaluated in the study (TA-18 and TA-46). Results of the study were applied in the safety analysis report for Area G, which includes LANL's radioactive waste disposal facility (LANL 1995c). An earthquake of this magnitude was determined not to pose a hazard in terms of waste buried below the surface at Area G. Therefore, it is postulated that an earthquake would not cause a surface rupture at MDA H because MDA H and Area G are on the same mesa within a mile of each other.

Rockfalls, landslides, and slope instability are triggered by any process that might destabilize supporting rocks. These are geo-hazards that could affect the Proposed Action and the No Action alternative. The natural fracturing (cooling cracks) mentioned above provide pathways for water, increasing the likelihood of freeze-thaw cycles or excessive rainfalls contributing to rockfalls at the mesa edge and to the intrusion of water into the disposal shafts. Preferential erosion of less welded portions of the tuffs could undermine the overlying, more densely welded layers (see Figure 14) resulting in rockfalls or landslides. Construction activity (creating roads or constructing buildings) could also contribute to slope instability. A study on potential mesa-edge stability at Pajarito Mesa (LANL 1995d) indicates that north-facing rims of canyons typically display large-scale mass movement features in a zone of about 100 to 200 ft (30 to 60 m) wide. In contrast, cliff failure on south rims is characterized by infrequent failure of narrow fracture-bounded tuff blocks. Because MDA H is located on the south-facing rim of Mesita del Buey, it is unlikely to experience cliff failure. The frequency of failure on the Pajarito Plateau is unknown but seismic shaking may provide a triggering mechanism. Since all of the mesas of the Pajarito Plateau are composed of the same geologic units (Bandelier Tuff), the conclusions of the study of Pajarito Mesa are directly applicable to other mesas at LANL.

3.6 Human Health

This section considers the health of LANL site remediation workers and project staff working at MDA H. These two categories of receptors are evaluated in this EA because each category of worker is either involved in routine site inspections, remediation, or waste transportation activities at LANL. Wastes from LANL are transported to either onsite or offsite disposal sites and members of the public could also be affected by these transportation activities.

The health of LANL workers is routinely monitored depending upon the type of work performed. Health monitoring programs for LANL workers consider a wide range of potential concerns including exposures to radioactive materials, hazardous chemicals, and routine workplace hazards. In addition, LANL workers involved in hazardous operations are protected by engineering controls and required to wear appropriate PPE. Training is also required to identify and avoid or correct potential hazards typically found in the work environment and to respond to emergencies. All work performed at LANL is subject to the Integrated Safety Management System. This is a five-step process that defines a systematic approach to actions taken before, during, and after work is performed. Because of the various health monitoring programs, the requirements for PPE, and routine health and safety training, LANL workers are generally considered to be a healthy workforce with a below average incidence of work-related injuries and illnesses.

LANL employees monitor environmental media for contaminants that could affect members of the public. This information is reported to regulatory agencies, such as the NMED, and to the public through various permits and reporting mechanisms and it is used to assess the effects of routine operations at LANL on the public. More information about environmental media monitoring and doses to the public is contained in the LANL Environmental Surveillance Report for 2002 (LANL 2004). The health of LANL workers and members of the public is also subject to various RCRA and OSHA requirements established to protect public health and safety during hazardous waste site remediation operations.

3.7 Transportation and Utilities

Regional and site transportation routes are the primary methods used to transport LANL-affiliated employees, commercial shipments, and also hazardous and radioactive material shipments. TA-54 is only accessed from Pajarito Road, which links State Road (SR) 4 and White Rock to LANL's TA-03. Pajarito Road carries about 8,000 vehicles on an average workday and is essentially a two-lane road with some wider sections to permit passing, acceleration, and deceleration at certain intersections. It is the primary conveyor of LANL commuter traffic from White Rock. Pajarito Road is open only to LANL traffic; a badge or proper documentation is required for access into LANL beyond the checkpoints. A segment of SR 4 from Rover Boulevard in White Rock to East Jemez Road traverses land belonging to the Pueblo of San Ildefonso (the San Ildefonso Sacred Area). The DOE and San Ildefonso Pueblo renegotiated a 30-year easement on this stretch of highway in 2000.

The Pajarito East utility corridor carries major utilities to TA-54. Utilities include water lines, sanitary sewer lines, natural gas distribution lines, electrical transmission and distribution lines, and communications lines.

3.8 Noise

Noise is defined as unwanted sound. Noise is categorized into two types: *continuous noise* and *impulsive* or *impact noise*. The intensity of sound is measured in decibel (dB) units and has been modified into an A-weighted frequency scale (dBA) for setting human auditory limits.

Noise measured at LANL is primarily from occupational exposures. Occupational exposures are compared against an established OSHA Threshold Limit Value (TLV) (LANL 1999b). The TLV is administratively defined as the sound level to which a worker may be exposed for a specific work period without probable adverse effects on hearing acuity. The TLV for continuous noise is 85 dBA for an 8-hour workday. The TLV for impulsive noise during an 8-hour workday is not fixed because the number of impulses allowed per day varies depending on the dBA of each impulse, however, no individual impulse should exceed 140 dBA. An action level (level of exposure to workplace noise below the TLV but the use of PPE is recommended) has been established for noise in the workplace at LANL. The OSHA action level for both continuous and impulsive noise is 82 dBA for an 8-hour workday (LANL 1999b).

Environmental noise levels at LANL are highly variable and dependent on the generator and proximity to other sources of noise. Sources of environmental noise at LANL consist of background sound, vehicular traffic, routine operations, and periodic HE testing. Measurements of environmental noise around LANL facilities and operations typically average below 80 dBA. The averages of measured values from limited ambient environmental sampling in Los Alamos County were found to be consistent with expected sound levels (55 dBA) for outdoors in residential areas (Canter 1996). Because of the relatively remote location of TA-54, the ambient noise levels at and in the vicinity of TA-54 are typical of the environmental noise values found around LANL.

3.9 Environmental Justice

Presidential Executive Order 12898 (EO 12898) requires that Federal agencies, including the DOE, consider environmental justice when complying with the NEPA. Disproportionate adverse health and socioeconomic effects of proposed actions on minority populations (all people of color, exclusive of white non-Hispanics) and low-income families (household incomes less than $15,000 per year) must be identified and addressed. Operations such as establishing or closing hazardous waste landfills are of particular concern when considering whether there are environmental justice issues, as are the associated transportation ramifications of leaving wastes in place or relocating them. Populations that are subject to environmental justice considerations are present within 50 mi (80 km) of LANL, but there are no concentrations of minority or low-income populations residing at LANL or in Los Alamos County or at the Pueblo of San Ildefonso Sacred Area.

About 54 percent of the population within a 50-mi (80-km) radius of LANL is of minority status; 24 percent of the households have annual incomes below $15,000. Los Alamos County, which would be most directly affected by the Proposed Action, has a higher median family income and a much lower percentage of minority residents than the three surrounding counties. Los Alamos County is about 18 percent minority and, according to the 2000 Census, has one of the highest median household incomes in New Mexico at $78,993.

Families living below the poverty level[30] in Los Alamos County accounted for just 1.9 percent of all families. This compares with a median household income of $34,133 in the State of New Mexico, where 14.5 percent of all families live below the poverty level; median household incomes of $42,207 in Santa Fe County where 9.4 percent of families live below the poverty level; and $29,429 in Rio Arriba County where 16.6 percent of families live below the poverty level (USCB 2000).

The Pueblo of San Ildefonso is adjacent to Los Alamos County and LANL and meets the environmental justice criteria for minority (Native American) populations; however, the median household income was $30,457 in 2000; 12.4 percent of the families at the Pueblo earned below the poverty level. The three other Accord Pueblos of Santa Clara, Cochiti, and Jemez have median household incomes of $30,946, $35,500, and $28,889, respectively, and 16.4 percent, 13.2 percent, and 27.2 percent, respectively, of the families live below the poverty level at these three Pueblos. Pojoaque Pueblo has a median household income of $34,256; 11.3 percent of families there live below the poverty level (USCB 2000).

[30] Poverty level: Following the Office of Management and Budget’s Directive 14, the Census Bureau uses a set of money income thresholds that vary by family size and composition to detect who is poor. If the total income for a family falls below the relevant poverty threshold, then the family is classified as being “below the poverty level.”

3.10 Socioeconomics

LANL and Los Alamos County operations have a notable and positive influence on the economy of north-central New Mexico. Specifically, in FY01 (the latest year for which such information is available) LANL had an operating budget that was 1.667 billion dollars and a total workforce of 13,570. Salaries and benefits accounted for 880 million dollars. This translated into a 3.8 billion dollar impact on the tri-county region that includes Los Alamos, Santa Fe, and Rio Arriba Counties. In effect, nearly one of every three jobs in the tri-county region was created or supported by LANL. FY01 procurements in northern New Mexico were 357 million dollars (LANL 2002b). About 80 percent of the jobs created indirectly by LANL in the region occurred in the trade, finance, insurance, real estate, and services sectors (DOE 1999a).

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4.0 Environmental Consequences of Implementing the Proposed Action and the No Action Alternative

The environmental consequences of selecting and implementing a corrective measure option at MDA H within TA-54 are described in the following sections, 4.1 through 4.9. Resources are discussed in the same order as they were presented in Chapter 3.

4.1 Environmental Restoration and Waste Management

4.1.1 No Action Alternative

Under the No Action Alternative, MDA H would not undergo any corrective measure implementation. There would be no effect to waste management facilities at LANL currently receiving wastes.

4.1.2 Proposed Action

Environmental restoration workers at LANL would be involved in any corrective measure option implemented at MDA H. The waste generated by implementing corrective measure Options 1 through 5 would be well within the capability of the existing LANL waste management program. Corrective measure activities at MDA H would decrease the number of LANL mesa-top MDAs requiring remedial action by about 10 percent.

All five corrective measure options would fail to address minor vapor phase transport and contamination already present in the tuff. Even the excavation and removal options would not address this issue because residuals would likely still be present even after complete excavation. Some measure of vapor phase migration of VOCs and tritium would continue under all corrective measure options and the No Action Alternative, but would decrease with time due to bioremediation, decomposition, volatilization, and radioactive decay.

Corrective Measure Option 1: Upgrade Existing Surface

Under corrective measure Option 1, there would be no waste removal from MDA H. There would be no effect to existing waste management systems. No new landfills would be required. Routine monitoring and maintenance activities may produce a very small amount of operational waste from site workers.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

Under corrective measure Option 2, there would be no waste removal from MDA H. The effects for this option are expected to be the same as for corrective measure Option 1. No new landfills would be needed.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Under corrective measure Option 3, there would be no waste removal from MDA H. There would be no effect to existing waste management systems. No new landfills would be needed.

Corrective measure Options 3a and 3b would produce implementation wastes: uncontaminated borehole cuttings would be stockpiled as crushed tuff for incorporation into the final onsite cap; contaminated drill cuttings would be disposed of in accordance with existing LANL waste management procedures. Routine monitoring and maintenance activities may produce a very small amount of operational waste from site workers.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

Waste types and quantities generated by the excavation and removal of wastes from the MDA H shafts would not be likely to result in substantial effects to existing waste management disposal operations. No new landfills would be required. Under corrective measure Option 4, DOE would pursue maximal offsite disposal of wastes resulting from the implementation of excavation and removal activities. It is expected that the majority of waste produced by corrective measure activities at MDA H would be LLW. The NTS facilities for waste disposal, as well as existing commercial waste disposal facilities in Washington and Utah, have the capacity to accept the waste types and waste volumes expected to be generated by implementation of this corrective measure option. Small amounts of waste generated by site workers during excavation and removal activities would be handled, packaged, and disposed of in the same manner as the wastes generated by other activities at LANL.

About 45,000 yd^3 (34,200 m^3) of clean overburden material would be returned to the MDA H site to be used as backfill material. About 5,000 yd^3 (3,800 m^3) of overburden material (about 10 percent of the total) is likely to be characterized as LLW, hazardous waste, or mixed waste and would require transportation offsite to the NTS for LLW or to existing commercial waste disposal facilities for hazardous or mixed waste. In addition to this volume, an additional 1,500 yd^3 (1,140 m^3) of excavated waste may require transportation offsite to existing commercial waste disposal facilities. About 187,000 lbs (84,150 kg) of LLW DU and an additional 94,000 lbs (42,300 kg) of non-DU LLW of other radionuclides could be shipped offsite from LANL to the NTS or to appropriately licensed commercial facilities such as the above ground engineered disposal cell facility near Clive, Utah. A portion of the lithium compounds, plastics, and graphite (an estimated total of 74,000 lbs [33,300 kg], about 40 yd^3 [30.4 m^3]) may require disposal offsite in a hazardous waste permitted disposal unit. The estimated amount of metal that could be recycled or disposed of in the DOE system, including LANL, is about 129,000 lbs (58,050 kg).

The 5,000 lb (2,250 kg) of HE in the MDA H inventory would be packaged in billets, as described previously, and transported to TA-16 at LANL for deactivation through burning (flashing). After flashing, any residual ash would be sampled, analyzed to ensure that no detonable HE remains, packaged, and sent to Area G for storage and final disposition. Depending on the nature of the HE waste, there may be no ash remaining after flashing.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Waste types and quantities generated by the excavation and removal of wastes from the MDA H shafts would not be likely to result in substantial effects to existing waste management disposal operations. It is expected that the majority of waste produced by excavation and removal activities under corrective measure Option 5 would be LLW. LLW generated by excavation and removal activities would be disposed of at Area G, TA-54, and would not affect the Area G operations. Although the current disposal site footprint has limited waste capacity, adequate room for expansion exists within Area G for additional LLW disposal (DOE 1999a). The SWEIS analyzed expansion into Zones 4 and 6 of Area G and DOE made the decision in 1999 to expand LLW disposal at LANL into these areas. Zone 4 is about 30 ac (12 ha), but some of this area would likely not be developed for disposal cells due to the presence of groundwater monitoring wells, a utility easement, and archaeological sites. Zone 6 is slightly less than 40 ac (16 ha). Some of this area may not be developed for disposal cells because the required 50-ft (15-m) setback from the cliff edge may be difficult to attain and still avoid Mesita del Buey Road. Even with these development constraints, the expansion footprint into Areas 4 and 6 would likely be sufficient for as long as 130 years or more of LLW disposal at LANL.

About 45,000 yd^3 (34,200 m^3) of clean overburden material would be returned to the MDA H site to be used as backfill material. About 5,000 yd^3 (3,800 m^3) of overburden material (about 10 percent of the total) is likely to be characterized as LLW, hazardous waste, or mixed waste and would require disposition at Area G for LLW or at existing commercial waste disposal facilities for hazardous and mixed waste. About 187,000 lbs (84,150 kg) of LLW DU and an additional 94,000 lbs (42,300 kg) of non-DU LLW of other radionuclides could be disposed of at Area G. A portion of the lithium compounds, plastics, and graphite (an estimated total of 74,000 lbs [33,300 kg], about 40 yd^3 [30.4 m^3]) may require disposal offsite in a hazardous-waste-permitted disposal unit. The estimated amount of metal that could be recycled or disposed of in the DOE system, including LANL, is about 129,000 lbs (58,050 kg). The 5,000 lb (2,250 kg) of HE in the MDA H inventory would be managed at TA-16, as described in corrective measure Option 4. Any residual ash would be disposed of at Area G.

A portion of the lithium compounds, plastics, and graphite (an estimated total of 74,000 lbs [33,300 kg]) may require disposal offsite in a hazardous-waste-permitted disposal unit. LANL would treat about 4,340 lb (1,953 kg) of waste lithium hydride to remove the hazardous waste characteristics. Successful treatment could result in no regulated hazardous residuals requiring disposal. Residual waste would be discharged to the LANL sanitary wastewater treatment system. Small amounts of waste generated by site workers during excavation and removal activities would be handled, packaged, and disposed of according to LANL's waste management program (LANL 1998a).

4.2 Water Resources (Surface and Ground)

4.2.1 No Action Alternative

Under the No Action Alternative, the MDA H site would be left in its current state. Groundwater and surface water quality would not likely be adversely affected from implementation of the No Action Alternative. Even the more stable and long-lived radionuclides and heavy metals would not be expected to migrate to the regional aquifer within 1,000 years, if at all. Potential water resources effects from implementing the No Action Alternative could include the presence of minor amounts of water in the disposal shafts that could lead to minor migration of contaminants from the disposal shafts.

4.2.2 Proposed Action

Corrective Measure Option 1: Upgrade Existing Surface

It is unlikely that either surface or ground water quality would be adversely affected from implementing this corrective measure option over the next 1,000 years. It is not expected that major contaminant transport over the next 1,000 years would result from implementing this corrective measure option because of chemical and isotope decay and waste material that is non-leaching. Water quality consequences that could result from implementing this corrective measure option include the possibility of minor contaminant transport by groundwater and vapors (LANL 1992b, LASL 1973). Upgrading and maintaining the MDA H surface cover would provide additional protective measures minimizing the amount of moisture that could migrate through the waste materials disposed in the shafts over the No Action Alternative. In addition, the 3-ft- (0.9-m-) thick concrete caps present over each shaft would provide additional moisture protection to the shafts. The gravel and soil admixture would serve to retard erosion of the cover until the vegetative cover is established enough to provide additional erosion control and ET effects.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

It is not expected that either surface or groundwater quality would be adversely affected from implementing this corrective measure option over the next 1,000 years. Environmental effects that could result from implementing this corrective measure option include the possibility of minimal contaminant transport by groundwater and vapors (LANL 1992b, LASL 1973); potential environmental effects from implementing this corrective measure option are also as described above for corrective measure Option 1. The engineered ET cover would likely enhance the performance of the retardation of moisture migration through the shafts and also erosion of the cover over time as compared to corrective measure Option 1.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

It is not expected that either surface or ground water quality would be adversely affected from implementing this corrective measure option over the next 1,000 years. Waste left in place would still be subject to minor contaminant transport by groundwater or vapors (LANL 1992b, LASL 1973). Potential adverse environmental effects from implementation of this corrective measure might result from the potential for an Alkali-Silica Reaction (ASR). This reaction can occur between certain aggregate types (in this case, tuff) and the alkalis in the pore solutions of concrete grout to form a silica gel. If ASR were to occur after implementation, the confinement mechanism of corrective measure Options 3a and 3b could provide little additional physical containment. Although 100 percent integrity of the beneath shaft seal could not be verified, the correct cement mixture formulation would still achieve the primary objective of corrective measure Option 3, to minimize the potential for human and biotic intrusion.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

The long-term effects to water resources that could result from implementing this corrective measure option would likely be slightly beneficial. Total excavation of the inventory of the

MDA H shafts would essentially return this portion of Mesita del Buey to its natural state and would minimize any potential for radionuclide, heavy metal, and organic contaminant transport from wastes present in the shafts at MDA H. Gaseous state contamination in the tuff surrounding the shafts would be expected to self remediate over time.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

The long-term effects to water resources that could result from implementing this corrective measure option would likely be slightly beneficial. Total excavation of the inventory of the MDA H shafts would essentially return this portion of Mesita del Buey to its natural state and would minimize any potential for any radionuclide, heavy metal, and organic contaminant transport from the shafts as the waste would be removed. Gaseous state contamination in the tuff surrounding the shafts would be expected to self remediate over time. Disposal of the waste at another permitted disposal area at LANL could result in the development of the same issues that have necessitated a corrective action at MDA H.

4.3 Air Quality Effects

4.3.1 No Action Alternative

No change to the air quality in the Los Alamos airshed would be expected to result from implementing the No Action Alternative. Under the No Action Alternative, particulates, HAPs, and VOCs would continue to be emitted from MDA H at very low levels similar to current levels. These levels are well below the threshold limits established by the CAA (40 CFR 50). Tritium and VOC emissions would decline over time due to natural bioremediation, decomposition, volatilization, and radioactive decay. LANL would continue to be in compliance with air quality standards and the air quality attainment status of the area would not change.

4.3.2 Proposed Action

Corrective Measure Option 1: Upgrade Existing Surface

No change to the air quality in the Los Alamos airshed would be expected to result from implementing corrective measure Option 1. Air emissions would be expected to be similar to those expected for the No Action Alternative if corrective measure Option 1 were implemented. No MDA H shaft contaminants would be disturbed. Wind erosion at the site would be reduced by the upgrades to the cover of the shaft over conditions of the No Action Alternative. NNSA and UC staff at LANL would continue to be in compliance with air quality standards and the attainment status of the area would not change. Tritium and VOC emissions from MDA H would be similar to, or less than, those associated with the No Action Alternative; VOC and tritium emissions would decline over time as a result of bioremediation, decomposition, volatilization, and radioactive decay.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

No change to the air quality in the Los Alamos airshed would be expected to result from implementing corrective measure Option 2. Air emissions would be expected to be similar to those expected for the No Action Alternative if corrective measure Option 2 were implemented.

No MDA H shaft contaminants would be disturbed. Wind erosion at the site would be reduced by the enhancements to the cover and shaft caps over the conditions of corrective measure Option 1. NNSA and UC staff at LANL would continue to be in compliance with air quality standards and the attainment status of the area would not change. Tritium and VOC emissions from MDA H would be similar to, or less than, those associated with the No Action Alternative. VOC and tritium emissions would decline over time as a result of bioremediation, decomposition, volatilization, and radioactive decay.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

No change to the air quality in the Los Alamos airshed would be expected to result from implementing corrective measure Option 3. Air emissions would be expected to be similar to those expected for the No Action Alternative if corrective measure Option 3 were implemented. Wind erosion at the site would be reduced by the enhancements to the cover and shaft caps, as well as the construction of side walls to the shafts. NNSA and UC staff at LANL would continue to be in compliance with air quality standards and the attainment status of the area would not change. Tritium and VOC emissions from MDA H would be less than those associated with the No Action Alternative. Tritium and VOC emissions would decline over time as a result of bioremediation, decomposition, volatilization, and radioactive decay.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

No change to the air quality in the Los Alamos airshed would be expected to result from implementing corrective measure Option 4. The LANL area would remain an attainment area for air quality. Air emissions would be greater than anticipated for the No Action Alternatives or for corrective measure Options 1 through 3. Emissions would be regulated by NMED and the EPA. Corrective measure operations would conform to applicable NMED and EPA permitting requirements for LANL. Other LANL operations might be curtailed to maintain LANL emissions within permitted levels.

Dust or PM, HAPs, and VOCs would result from excavating, transporting, and storing soil and waste from MDA H over the short term. Particulate emissions would be controlled with specific best available control measures, such as wetting soil or applying tackifiers, that would be implemented for the removal operations. Potential localized air quality effects would be temporary.

Emissions of PM, HAPs, VOCs, and radioactive materials would result from waste segregation and sorting operations, from processes used to declassify materials (particularly from incineration of plastics), and from burning HE-contaminated materials. The volume of HE-contaminated waste that would require treatment at TA-16 is in excess of 5,196 lbs (2,318 kg). Treatment of the entire HE inventory would probably require that the waste treatment be performed over several years for these operations and the rest of LANL operations to remain within the annual emissions parameters of the TA-16 Open Burn Permit.

Bounding estimates for radioactive emissions, using the entire contaminant inventory of the shafts as the source term, for recovering, sorting, segregating, and declassifying materials at MDA H were calculated according to RAD NESHAP (40 CFR 61) protocols. The potential dose from the recovery and processing operations to the maximally exposed individual (MEI) member of the public, at the White Rock Nazarene Church (which is the nearest permanent offsite residence or business hypothetically located to MDA H), would be 0.26 millirem (mrem) per year if no mitigating measures were employed. However, under the Proposed Action, the recovery, sorting, segregating, and declassification (such as crushing, cutting, dissolving, or heating to temperatures below 3632°F [2000°C]) operations would be conducted in a HEPA-filtered enclosure. The resulting potential dose to the MEI would be 0.017 mrem per year. Radioactive air emissions would be monitored and would not exceed applicable air quality standards. No long-term adverse effects to air quality from implementing corrective measure Option 4 would be expected to occur. Contaminants already present in the soil around MDA H would continue to decay or be decomposed and would lessen over time.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Air emissions resulting from implementing corrective measure Option 5 would be the same as those expected from implementing corrective measure Option 4. No change to the air quality in the Los Alamos airshed would be expected to result from implementing corrective measure Option 5. The LANL area would remain an attainment area for air quality. Potential doses from emissions of radioactive material and hazardous wastes are expected to be the same as for corrective measure Option 4.

4.4 Geology – Environmental Consequences

4.4.1 No Action Alternative

Under the No Action Alternative, the waste would be left in place within the disposal shafts. There would be no effects to geology resources as a result of implementing the No Action Alternative. The waste disposal shafts are located at a suitable distance (about 90 ft [30 m] for the shaft closest to the road break) from the Pajarito Road break (the cliff edge), so that it is expected that they should remain intact for more than 10,000 years. Slope stability would be subject to natural processes such as erosion, landslides, rockfalls, rainfalls, freezing and thawing, and seismic events. These mass-wasting mechanisms could cause cliff edge instability and retreat towards the disposal shafts over time, but would be unlikely to adversely affect waste within MDA H shafts over the next 10,000 years or more.

4.4.2 Proposed Action

Corrective Measure Option 1: Upgrade Existing Surface

Under this corrective measure option, the waste would be left in place within the disposal shafts. Potential geologic effects on corrective measure Option 1 are the same as those expected for the No Action Alternative.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

Under this corrective measure option, the waste would be left in place within the disposal shafts. Potential geologic effects on corrective measure Option 2 are the same as those expected for the No Action Alternative.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Under this corrective measure option, the waste would be left in place within the disposal shafts. Potential geologic effects on corrective measure Option 3 are the same as those expected for the No Action Alternative.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

Total excavation of the MDA H shafts would essentially return this portion of Mesita del Buey to its natural state. A minor geologic effect would be expected from implementation of this corrective measure option. The shafts that would be backfilled with the soil and tuff overburden material would not be solid ground and would be susceptible to subsidence (settling) unless the tuff is packed well as it is put into the shafts.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Total excavation of the MDA H shafts would essentially return this portion of Mesita del Buey to its natural state. Geologic effects expected to result from implementation of this corrective measure option would be similar to those described for corrective measure Option 4.

4.5 Human Health

4.5.1 No Action Alternative

Under the No Action Alternative, there would be no potential for injuries to LANL or site workers from waste removal or site maintenance activities as would be the case under the corrective measure options considered for the Proposed Action. No exposures to earthmoving and excavation activities, site barrier or encapsulation work, or hazardous waste management operations (including radioactive materials and HE) would take place at MDA H. Wastes would not be transported from the MDA H site to either an onsite or an offsite TSD facility.

The current design of the MDA H cover has been reliable and effective in preventing releases of wastes (with the exception of subsurface vapor releases of VOCs and tritium) from the shafts at MDA H. This cover has had minimal maintenance in its 40-year lifetime. Contaminant transport modeling of the effectiveness of the existing cover demonstrated that no contaminants would be expected to reach the regional groundwater table beneath MDA H during the 1,000-year evaluation period. If an episodic event, such as a severe climate change, were to occur, the site would be inspected and monitored to detect any potential releases from the shafts.

4.5.2 Proposed Action

Based on the results of the long-term risk assessments conducted for corrective measure Options 1, 2, and 3 at MDA H, potential human health effects related to cancer risk from chemicals, systemic hazard from chemicals, and radiation dose from radionuclides would be minimal even beyond the point in time when institutional controls were removed after 100 years. The physical nature of the disposed material and the presence of a crushed tuff and gravel mulch cover provide substantial protection to human receptors under both residential and recreational land use scenarios. Therefore, the implementation of this containment corrective measure option would be expected to provide protection of human health over a 1,000-year time period.

Corrective measure Options 2 and 3 are variations of corrective measure Option 1 with additional controls designed to enhance system performance. Therefore, corrective measure Options 2 and 3 would be less likely to affect human health, if implemented. Corrective measure Options 1, 2, and 3 would provide minimum exposure to workers. No local long-term potential human health effects would be associated with corrective measure Options 4 and 5 because the material in the MDA H shafts would be removed and disposed of in permitted facilities or recycled, where appropriate. There could be human health effects associated with implementing these Proposed Action options based on construction risks. These potential effects are discussed below.

Corrective Measure Option 1: Upgrade Existing Surface

Routine hazardous waste site corrective actions conducted under corrective measure Option 1 would pose very minor adverse health risks to LANL workers. Potential adverse effects could range from relatively minor (such as cuts or sprains) to major (such as broken bones, excessive exposures, or fatalities). To reduce the risk of serious injuries, all site corrective action contractors would be required to submit and adhere to a Health and Safety Plan. In addition, LANL staff would provide site-specific hazard and radiological training to workers, as needed.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

Human health effects under corrective measure Option 2 would be essentially the same as those discussed under corrective measure Option 1. Routine hazardous waste site corrective actions conducted under corrective measure Option 2 could pose very minor adverse health risks to LANL workers.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Human health effects under corrective measure Option 3 would be similar to those discussed under corrective measure Option 1. Site containment activities would be expanded to include waste encapsulation operations including the use of a high-pressure grout delivery line. About 24 to 38 employees would be required during peak encapsulation operations. The use of a high-pressure grout or concrete delivery line could pose an additional physical hazard to site workers during the construction phase of the project. In the event of a line rupture or loss of line control, workers could be injured by the release of grout or concrete under high pressure, from the violent movement of an out-of-control line, or from shrapnel and fragments from the ruptured line. Adherence to safe operating procedures (such as formal start-up and shut-down protocols, designated worker exclusion areas, emergency shut-offs, and operator training) would reduce the risk of serious injuries due to a high-pressure delivery line failure. Longer-term adverse health effects on LANL workers and members of the public from maintenance activities at the site would be reduced even further than under corrective measure Option 1. Very minor adverse health effects would still be possible.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

Under corrective measure Option 4, the waste in MDA H would be removed and sent to a permitted offsite disposal facility. Any such facility would be required to have equivalent performance in terms of protecting human health and the environment as met by corrective measure Options 1 through 3. Thus, corrective measure Option 4 would provide the same level of protection for human health as corrective measure Options 1, 2, and 3, and complies with all standards for protection of human health but to a different community. However, both corrective measure Options 4 and 5 would result in the maximum exposure to workers during waste excavation, sorting, and declassification under both inert atmosphere or ambient air conditions.

Excavation and offsite disposal activities proposed under corrective measure Option 4 would increase the short-term potential for adverse health effects on workers and the public during the removal operations at MDA H. About 75 to 85 employees would be required during peak waste removal operations. Waste and contaminated soil excavation, packaging, and transportation activities are generally more hazardous than site containment operations described under corrective measure Options 1, 2, and 3. Excavation could pose physical hazards from the removal of large amounts of dirt, rock, and wastes. There is also a potential for workers to be struck by falling materials or to experience falls when working in or near excavated trenches. The need for workers, especially heavy equipment operators and truck drivers, to work in proximity to excavated materials may pose additional chemical, radiation, and explosives hazards. Inhalation and ingestion of and dermal contact with contaminated dust could also pose a health hazard to site workers. Adherence to safe work protocols, use of remote handled devices, use of PPE, and the development of safety mitigation (such as monitoring for chemicals, radiation, and HE) would reduce the risk of contaminant exposures or injuries to site workers. Excavation of the MDA H wastes would be complex, but it would be safe due to training and experience of workers and implementation of the Integrated Safety Management process. The safety analysis and authorization basis process would also be a key element in the safe excavation of wastes from the shafts.

Members of the public could be exposed to chemical, radiation, and HE hazards when wastes are removed from the shafts and transported to offsite disposal facilities. On average, about one vehicle per week over 48 months would be loaded with waste and traveling on public roads. The use of road closures when onsite at LANL, the use of public roads designated for the transport of hazardous materials when offsite, and properly packaged wastes and placarded trucks should preclude unplanned exposures or serious adverse health effects to the public.

Under this corrective measure option, no local long-term health effects would occur to LANL workers or members of the local community since the wastes would no longer be present at MDA H. Because the offsite disposal facility would be designed, built, and permitted in accordance with RCRA requirements, long-term health effects from offsite disposal should pose only a minor health risk to the public.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Under corrective measure Option 5, the waste in MDA H would be removed and disposed of as LLW at Area G at TA-54 or, as appropriate, at a DOE or commercial offsite permitted RCRA-regulated landfill or recycle facilities. Such facilities are required to meet the same human health criteria of dose, risk, radon flux, and hazard index that have been demonstrated to be met by corrective measure Options 1 through 4. Thus, corrective measure Option 5 would provide the same level of protection for human health as corrective measure Options 1 through 4 and comply with all standards for protection of human health. Corrective measure Option 5 would provide workers with the maximum exposure to contaminants during waste excavation, sorting, and declassification.

Potential human health effects from excavation activities under corrective measure Option 5 would be similar to those identified under corrective measure Option 4. Transportation activities offsite and onsite would pose the same kinds of potential health risks to workers and the public as discussed under corrective measure Option 4. However, the quantity of waste to be hauled offsite would be less than under corrective measure Option 4. Fewer truckloads of waste would decrease the potential exposure of members of the public to hazards related to waste transport.

4.6 Transportation and Utilities

4.6.1 No Action Alternative

Under the No Action Alternative, MDA H would not undergo corrective measure activities. There would be no additional transportation needs or truck transport trips generated by the movement of people, services, goods, and, possibly, wastes related to closure of MDA H. There would be no changes to existing utilities at TA-54 and no changes to the electric power consumption or water consumption at LANL.

4.6.2 Proposed Action

Each of the corrective measure options affects transportation and utilities differently because of equipment and personnel requirements and the amount of excavated materials. The effects are all temporary. All waste requiring offsite disposal would be transported along Pajarito Road and SR 4. Negligible increases in LANL electric and water consumption would occur because of the implementation of any of the corrective measure options considered; work at the site under corrective measure Options 1, 2, and 3 would require few, if any, water trucks for dust suppression, proposed office personnel, and waste removal workers uses. Corrective Measure Options 4 and 5 would require water and electric use over about 48 months of site work but consumption would be minor compared to total LANL energy consumption.

Corrective Measure Option 1: Upgrade Existing Surface

Under corrective measure Option 1, there would be no waste removal from MDA H. There would be no additional truck trips to haul generated waste materials offsite. In the short term, there would be a few construction vehicles used for upgrading the existing cover; the construction vehicles would use Pajarito Road and connecting LANL roads. Peak staffing would be estimated to be 10 to 14 workers. Implementing this corrective measure option would not appreciably affect area traffic because the additional vehicle trips would be a negligible increase on Pajarito Road and connecting roads. Parking would be provided for these vehicles near the project in a manner that would minimize effects on any natural and cultural resources.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

Under corrective measure Option 2, there would be no waste removal from MDA H. Effects on transportation are expected to be the same as those described for corrective measure Option 1.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Under corrective measure Option 3, there would be no waste removal from MDA H. Effects on transportation are expected to be the same as those described for corrective measure Option 1.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

Under corrective measure Option 4, all waste requiring offsite disposal would be transported via Pajarito Road. It is estimated that a maximum of 1,500 yd^3 (1,140 m^3) of excavated waste, including LLW, recyclable metal, hazardous, and mixed waste, and an additional 5,000 yd^3 (3,800 m^3) of overburden material would be transported on public roads over about 48 months. About 325 to 650 truckloads, depending on their capacity, would be outbound with an equal number of return trips with empty haulers; this would mean, on average, one truck every day or every other day added to the local traffic and offsite road use. Transport of about 5,000 lb (2,250 kg) of HE to TA-16 at LANL would be performed at night in trucks designed especially for this purpose. A study would be performed to evaluate waste quantity shipped at one time, hours of transport, safeguards and security, and possible road closures. Utilities along Mesita del Buey Road would have to be protected or relocated, including the water line supplying Areas G and L.

Peak staffing is estimated to be 75 to 85 personnel. This would not appreciably affect local traffic because the additional trips would be less than a two percent increase on Pajarito Road and connecting roads. Parking would be provided for these vehicles near the project in a manner that would minimize any effects on natural and cultural resources.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Under corrective measure Option 5, LLW requiring onsite disposal would be transported to Area G via Mesita del Buey Road; HE waste would be transported within LANL to TA-16 via Mesita del Buey Road, Pajarito Road, and West Jemez Road; waste requiring offsite disposal would be transported via Pajarito Road. It is estimated that a maximum of 1,500 yd^3 (1,140 m^3) of excavated waste, including LLW and some hazardous and mixed waste to be treated at LANL, and an additional 5,000 yd^3 (3,800 m^3) of overburden material would be transported on LANL roads over about 48 months. About five to six truckloads of recyclable metal and about four to eight truckloads of hazardous or mixed waste that cannot be treated at LANL may be transported offsite over about 48 months. This would mean about one truckload of waste every three or four months added to the local traffic and offsite road use. About 325 to 650 truckloads, depending on their capacity, would be required with an equal number of return trips with empty haulers; this would mean, on average, one truck every day or every other day added to the traffic within LANL. Transport of about 5,000 lb (2,250 kg) of HE to TA-16 would be performed at night in trucks designed especially for this purpose. A study would be performed to evaluate waste quantity shipped at one time, hours of transport, safeguards and security, and possible road closures. Utilities along Mesita del Buey Road would have to be protected or relocated, including the water line supplying Areas G and L.

Peak staffing is estimated to be 75 to 85 personnel. Implementing corrective measure Option 5 would not appreciably affect local traffic because the additional trips would be less than a two percent increase on Pajarito Road and connecting roads. Parking would be provided for these vehicles near the project in a manner that would minimize effects on any natural and cultural resources.

4.7 Noise

4.7.1 No Action Alternative

Under the No Action Alternative, ambient noise levels would remain unchanged in the vicinity of MDA H. Environmental noise levels in and around MDA H would be expected to remain below 80 dBA on average.

4.7.2 Proposed Action

Corrective Measure Option 1: Upgrade Existing Surface

Under corrective measure Option 1, the Proposed Action could result in a temporary increase in noise levels associated with various remediation activities proposed for MDA H over the six-month time period required for implementation. At the completion of these activities, noise levels would return to existing levels. Noise generated by the Proposed Action is not expected to have an adverse effect on either LANL or site workers or members of the public.

Heavy equipment would be used during site preparation and for earthmoving work. Heavy equipment such as front-end loaders and backhoes would produce intermittent noise levels at around 73 to 94 dBA at 50 ft (15 m) from the work site under normal working conditions (Canter 1996, Magrab 1975). Truck traffic would occur frequently, but would generally produce noise levels below that of the heavy equipment. PPE would be required if site-specific work produced noise levels above the action level at LANL of 82 dBA. Based upon a number of physical features that can attenuate noise, such as topography or vegetation, noise levels should return to background levels within about 200 ft (66 m) of the noise source (Canter 1996). Since sound levels would be expected to dissipate to background levels before reaching publicly accessible areas or undisturbed wildlife habitats, they should not be particularly noticeable to members of the public or disturb local wildlife.

Noise generated by activities under this corrective measure option would be temporary (up to six months), of low to moderate intensity, highly localized, and would be consistent with noise levels in nearby developed areas or on existing roads at LANL. No adverse or long-term effects on workers at LANL, the public, or the environment would be expected from noise levels generated by activities planned under this corrective measure option.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

Noise effects under corrective measure Option 2 would be essentially the same as those discussed previously under corrective measure Option 1. Routine site containment activities would include the construction of an engineered cover, but these operations would continue to have only a temporary and minor effect on noise levels.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Temporary noise effects under corrective measure Option 3 would be greater than those discussed under corrective measure Option 1 during the 12-month implementation period. Routine site containment activities would be expanded to include waste encapsulation operations including the use of a high-pressure slurry delivery line. The use of a high-pressure delivery line and supporting equipment could pose an additional noise hazard to site workers. Equipment required to maintain pressure and push the grout through the delivery line (such as engines or pumps) would generate noise. Workers in the vicinity of this equipment may be exposed to elevated noise levels requiring hearing protection. Adherence to safe operating procedures (such as designated worker exclusion areas, use of PPE, and operator training) should preclude serious injuries from noise exposures associated with grout line operations. Noise levels would return to background levels when grouting operations are completed.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

Excavation and offsite disposal activities proposed under corrective measure Option 4 would increase the potential for noise effects on workers and the public over the 48-month implementation period. Waste excavation, packaging, and transportation activities would generate similar types of noise but also a higher noise level than site containment operations described under corrective measure Option 1. This higher noise level may require hearing protection for workers under certain conditions but should not adversely affect the public. Worksite monitoring for noise, adherence to safe work protocols, and the use of PPE should reduce the risk of injuries to site workers from elevated noise levels.

Traffic noise from waste transportation activities would not noticeably increase the present traffic noise level on roads at LANL. This corrective measure option would add about two additional truck round trips per week over 48 months to existing vehicular traffic at LANL. Therefore, traffic noise levels are not expected to have an adverse effect on LANL workers or the public.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Potential noise effects from excavation and transportation activities under corrective measure Option 5 would be similar to those identified under corrective measure Option 4. Excavation activities at MDA H would pose potential noise risks to workers and the public as discussed under corrective measure Option 4. However, onsite disposal at a location other than MDA H (such as at Area G or TA-16) would be by way of DOE and public roads. These roads could be closed when wastes are transported thereby reducing noise levels on publicly accessible roads. The total number of truck trips required to move wastes to a landfill or disposal site would not change. If materials are disposed of at Area G, the transportation of wastes over publicly accessible roads may not be needed, which would also reduce or eliminate public exposure to noise.

4.8 Environmental Justice

4.8.1 No Action Alternative

There would likely be no short-term disproportionate adverse effects to minority populations subject to environmental justice concerns under the No Action Alternative. No long-term issues regarding environmental justice would be expected as a result of implementing the No Action Alternative. Residents of San Ildefonso Pueblo have expressed concern that waste disposed of at TA-54 poses a possible environmental justice concern because this technical area is adjacent to their sacred lands. As discussed in Sections 4.1, 4.2, and 4.3, implementation of any of these corrective measure options would not be expected to adversely affect air or water quality or result in any contaminant releases above regulatory limits for a period of at least 1,000 years.

4.8.2 Proposed Action

Corrective Measure Option 1: Upgrade Existing Surface

Under corrective measure Option 1, there would be no waste removal from MDA H. Environmental justice effects would be the same as those for the No Action Alternative.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

Under corrective measure Option 2, there would be no waste removal from MDA H. Environmental justice effects would be the same as those for the No Action Alternative.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Under corrective measure Option 3, there would be no waste removal from MDA H. Environmental justice effects would be the same as those for the No Action Alternative.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

No long-term issues regarding environmental justice would be expected as a result of implementing corrective measure Option 4. Transporting wastes from LANL to another location would require that trucks use roads that traverse or are located near minority and low-income communities, including the Pueblos of San Ildefonso and Pojoaque, and possibly others depending upon the selected route to a disposal site. Implementation of corrective measure Option 4 would minimize the potential of possible future releases of contamination from MDA H.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

No long-term issues regarding environmental justice would be expected as a result of implementing corrective measure Option 5. Transporting wastes from LANL to another location would require that trucks use roads that traverse or are located near minority and low-income communities, including the Pueblos of San Ildefonso and Pojoaque, and possibly others depending upon the selected route to a disposal site. Users of the San Ildefonso Sacred Lands north of TA-54 would not be affected by implementation of corrective measure Option 5 since onsite LLW disposal at Area G is a normal, routine operation.

4.9 Socioeconomics

4.9.1 No Action Alternative

The population in Los Alamos County would not be expected to change as a result of implementing the No Action Alternative. Site maintenance and monitoring activities would be performed by existing LANL workers. There would be no increase in LANL employees and no effect on housing and public services.

4.9.2 Proposed Action

Corrective Measure Option 1: Upgrade Existing Surface

Socioeconomic effects for corrective measure Option 1 would be expected to be the same as for the No Action Alternative. Temporary construction jobs for 10 to 12 workers during the six-month implementation time period would be filled by existing LANL workers.

Corrective Measure Option 2: Replacement of the Existing Surface with an Engineered ET Cover

Socioeconomic effects for corrective measure Option 2 would be expected to be the same as for the No Action Alternative. Temporary construction jobs for 10 to 12 workers during the six-month implementation time period would be filled by existing LANL workers.

Corrective Measure Option 3: Partial or Complete Encapsulation and Use of Engineered Caps and an Engineered ET Cover

Socioeconomic effects for corrective measure Option 3 would be expected to be the same as for the No Action Alternative. Temporary construction jobs for 24 to 38 workers during the 12-month implementation time period would be filled by regional workers.

Corrective Measure Option 4: Complete Excavation with Maximal Offsite Disposal

Socioeconomic effects for corrective measure Option 4 would be expected to be the same as for the No Action Alternative. Temporary construction jobs for 75 to 85 workers during the 48-month implementation time period would be filled by regional workers.

Corrective Measure Option 5: Complete Excavation with Maximal Onsite Disposal

Socioeconomic effects for corrective measure Option 5 would be expected to be the same as for the No Action Alternative. Temporary construction jobs for 75 to 85 workers during the 48-month implementation time period would be filled by regional workers.

5.0 Accident Analysis

The Proposed Action is the implementation of a corrective measure at MDA H. All of the corrective measure options are centered around either containment of or excavation and complete removal of the waste inventory at MDA H. NEPA guidance recommends the use of a sliding-scale approach for considering, analyzing, and reporting accidents that might occur for a Proposed Action (DOE 2002). As such, only the risk-dominant accidents for the excavation and removal corrective measure options were chosen to represent the spectrum of postulated accidents considered and analyzed for the Proposed Action and discussed in this chapter. A discussion of a full spectrum of accidents analyzed for the excavation alternatives can be found in a report by Omicron (Omicron 2001). A risk assessment on potential worker and public risks from postulated accidents has concluded that accidents involving exposure of the public to radioactive or hazardous materials left in place at MDA H are not credible[31] (Omicron 2001). Excavation and removal corrective measure options including associated transportation pose the greatest risk to members of the public, albeit a small one. The risk to the public from all other activities is negligible. The risk to workers is dominated by standard industrial accidents and explosions and is most associated with site excavation activities.

Radioactive wastes were disposed of in MDA H from May 1960 through August 1986. The majority of the waste is DU (about 24 percent) and other radioactive material (an additional 24 percent). DU is almost 60 percent less radioactive than natural uranium and the potential chemical effects of DU can be of more concern than the radioactive effects. About 4,800 lbs (2,160 kg) of HE were disposed of in a single shaft and 47,000 lbs (21,150 kg) of HE-contaminated material (containing less than 1 percent HE) was disposed of throughout the nine shafts.

Slightly more than 150 potential accident scenarios have been postulated for the proposed MDA H corrective measure options. Process hazard analyses were performed on postulated accidents that failed to be screened out based on the likelihood of their occurrence and their potential effect on human health. Unmitigated and mitigated public, worker, and transportation risks associated with excavating MDA H have been assessed. The corrective measure activities assessed included site preparation; site excavation; sorting and segregation of waste; declassification, packing, and loading of waste; waste transportation; and site restoration. The spectrum of hazards considered included industrial hazards, fires, explosions, spills, and penetrating radiation.

5.1 Risk to the Public

Excavation of the waste would pose more threat to human health from accidents than containment of the waste; however, even excavation is relatively safe because it is not an extraordinary action for LANL workers. The relatively small quantity of potentially dispersible radioactive or hazardous material expected to be present in the shafts would minimize the risk of exposure to members of the public. Many accidents were postulated in which exposure to radiological material was the accident type, but all of these scenarios resulted in no or negligible dose consequences to members of the public (Omnicron 2001). The quantities of dispersible

[31] Credible means having a chance of occurrence of one in one million.

radiological and hazardous materials estimated to date to be present within MDA H and the resultant consequences from accidental exposure scenarios are too low to warrant quantitative consequence analysis. Potential human health impact from chronic (non-accident) exposures was addressed in the CMS Report (LANL 2003) and is summarized in Section 4.5 of this EA.

Regarding industrial accidents and the public, of 33 hazards (most with two or more initiating events) analyzed for the project, only an offsite transportation accident posed a credible threat to the public and the most serious effects were death or serious injury from the physical forces of the accident; thus a common industrial accident. Using current DOT statistics and an estimated maximum total number of miles of truck travel to move MDA H waste offsite, no (1.13×10^{-3} persons per year or about once every 900 years) member of the public would likely be killed from this activity for the duration of the project (Omicron 2001). Likewise, no (2.03×10^{-2} persons per year or about once every 50 years) member of the public would likely be seriously injured from this activity over the duration of the project.

5.2 Worker Risks

Most of the worker accident scenarios of relatively high-risk (likelihood multiplied by consequence) categories were standard industrial accidents that are common across the U.S. More than 30 standard industrial accidents that could result in severe worker injuries were identified. Most of these accidents were vehicle accidents, explosions, equipment failures, lightning strikes, electrocution, and operator errors.

Explosives are thought to constitute less than 1 percent (4,800 lb [2,160 kg]) of the waste in MDA H. This quantity is enough to be involved in explosion accidents; this was thoroughly evaluated in the risk assessment (Omicron 2001). Numerous postulated unmitigated accidents involving HE and potentially pyrophoric uranium in excavation corrective measure options could result in severe consequences to workers leading to immediate health effects or loss of life. Although the risk could be effectively mitigated through measures that substantially reduce the likelihood of such accidents (such as use of remote manipulators and excavation in an inert atmosphere), the consequences of such accidents could remain severe. Remote handling is a technology that would be used if an excavation corrective measure option were to be selected (LANL 2003); this would substantially reduce the potential adverse consequences to site workers from an accident of this type.

5.3 Containment Corrective Measure Options (1, 2, and 3)

Corrective measure options revolving around containment are safe and relatively free of accident hazards in comparison to the bounding accidents considered for the excavation and removal corrective measure options. Specifically, in the containment corrective measure options, the uranium hydride present in the shafts would be unlikely to result in a fire because the amount of oxygen present is not sufficient to allow the ignition of or sustain a hydride fire. Thus, the formation and presence of hydride in the shafts at MDA H would not pose a fire hazard (LANL 2003). In addition, any postulated accident involving the inhalation of uranium oxide scale would be virtually eliminated if one of the containment corrective measure options were selected.

5.4 Excavation Corrective Measure Options (4 and 5)

Explosion accidents were considered. Explosions caused by corrective measure activities are generally considered to occur with a frequency ranging from once every 100 years to once every 10,000 years. These events can result from the rupture of tanks used to store flammable gas or liquids to support corrective measure activities and could result in severe injuries or fatalities to workers. Explosions resulting in severe injuries or fatalities to workers could also occur if buried HE is impacted during remediation activities. The risk from explosion scenarios would be mitigated by implementing preventative controls, but the mitigated health effects to workers from such scenarios could still be severe. Therefore, risk is still considered to be of concern, and could require formally implementing more controls into procedures and training. The analyses (Omicron 2001) had sufficient scope to adequately represent the health risks associated with many types of explosions that could occur with the excavation corrective measure options. The need for engineering controls has also been identified to address three potential accidents, fire involving pyrophoric uranium hydride, ignition of HE, and inhalation of uranium oxide dust, that were identified in the CMS Report (LANL 2003) as associated with the excavation corrective measure options.

Remote operations for the excavation and removal of waste while in an inert atmosphere would enable the safe conduct of these activities. Standard dust control technologies and the use of personal protective equipment would effectively eliminate the uranium oxide dust hazard.

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6.0 Cumulative Effects

The effects of the Proposed Action when combined with the effects of other actions discussed in this section do not result in cumulatively significant impacts. Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes them. These effects can result from individually minor, but collectively significant, actions taking place over a period of time (40 CFR 1500-1508). The cumulative effect analysis in the LANL SWEIS already documents the regional effect of the expanded operations alternative and provides context for this EA. This section considers the Proposed Action and its possible effects on resources as related to any ongoing or reasonably foreseeable future actions.

Several resources were dismissed from cumulative effects consideration because they would not be affected by the Proposed Action and could not contribute collectively to ongoing or reasonably foreseeable actions (see Table 2). These were land use, floodplains and wetlands, and cultural, visual, and biological resources. Five other resources analyzed in this EA would not contribute significantly to cumulative effects, because the Proposed Action would not have major long-term or irreversible effects on water quality, geology (and soils), noise, human health, transportation, infrastructure, environmental justice, and socioeconomics. Air quality and waste management are discussed further in this section. This analysis concludes that there would not be cumulative effects on air quality, waste management, or other aspects of the environment. Moreover, some positive effects to resources, such as environmental restoration, would occur as a consequence of the Proposed Action to implement a corrective measure at MDA H within TA-54. In addition, the closure of Pajarito Road also reduces potential for negative cumulative effects since the public is less exposed to potential accidents associated with any corrective exposure option.

Air Quality The Proposed Action would not result in cumulatively significant impacts to air quality at LANL. There are no future actions likely to occur at LANL that might cause cumulative effects in the area of the Proposed Action. The attainment status of the area would not change. Other LANL operations might be curtailed to maintain LANL emissions within permitted levels. Therefore, the Proposed Action is not expected to result in a cumulative adverse effect on air quality at LANL.

Waste Management and Environmental Restoration Cumulative effects are postulated to be additive. For example, the impacts of corrective action-related waste management could be connected to management of waste from day-to-day routine operations, particularly if the same waste management facilities were used. The disposition of LLW from the MDA H inventory would contribute to the total volume of waste already in Area G. Further, estimated cumulative impacts are intended to represent the environmental impact range associated with specifically proposed actions or similar types of actions that may be undertaken eventually, in accordance with NMED-approved RFI and CMS implementation.

Waste generation at LANL during the next 10 years, both from decontamination and demolition of buildings and through environmental restoration efforts, could be large. However, waste types and quantities generated by the proposed excavation and removal of wastes from the MDA H shafts would be within the capacity of existing waste management systems and would not be likely to result in substantial effects to existing waste management disposal operations. Wastes generated by this remediation effort would be handled in accordance with applicable laws, regulations, and DOE orders and would be transferred to appropriate waste management facilities. Existing waste treatment and disposal facilities would be used according to specific waste types. When added to the much larger volume of environmental restoration waste generated at LANL, the Proposed Action would not contribute to significant adverse cumulative effects.

Implementation of a corrective measure option at MDA H would provide long-term beneficial impacts through the reduction of risks from contamination. Currently, LANL programs operate within regulatory requirements. The Proposed Action is an extension of LANL operations. It is expected that the cumulative effects would be commensurate with existing effects. DOE and LANL are pursuing an active program of reducing potential health risk through an as-low-as-reasonably-achievable (ALARA) policy for all personnel and the public. In addition to the reduction of cumulative effects associated with the Proposed Action, reduction of cumulative effects would be anticipated through meeting ALARA standards, preventing pollution, and minimizing waste.

7.0 Agencies Consulted

NNSA has determined that no consultation with the U.S. Fish and Wildlife Service is necessary regarding the potential effect of the Proposed Action on Federally protected threatened or endangered species or their critical habitat, as there would be no effect to these sensitive species or their critical habitat from the Proposed Action. In addition, no consultation with the State Historic Preservation Office is required. If any new cultural resource sites are identified during excavation or demolition activities, they would be evaluated and consultation would be undertaken as required.

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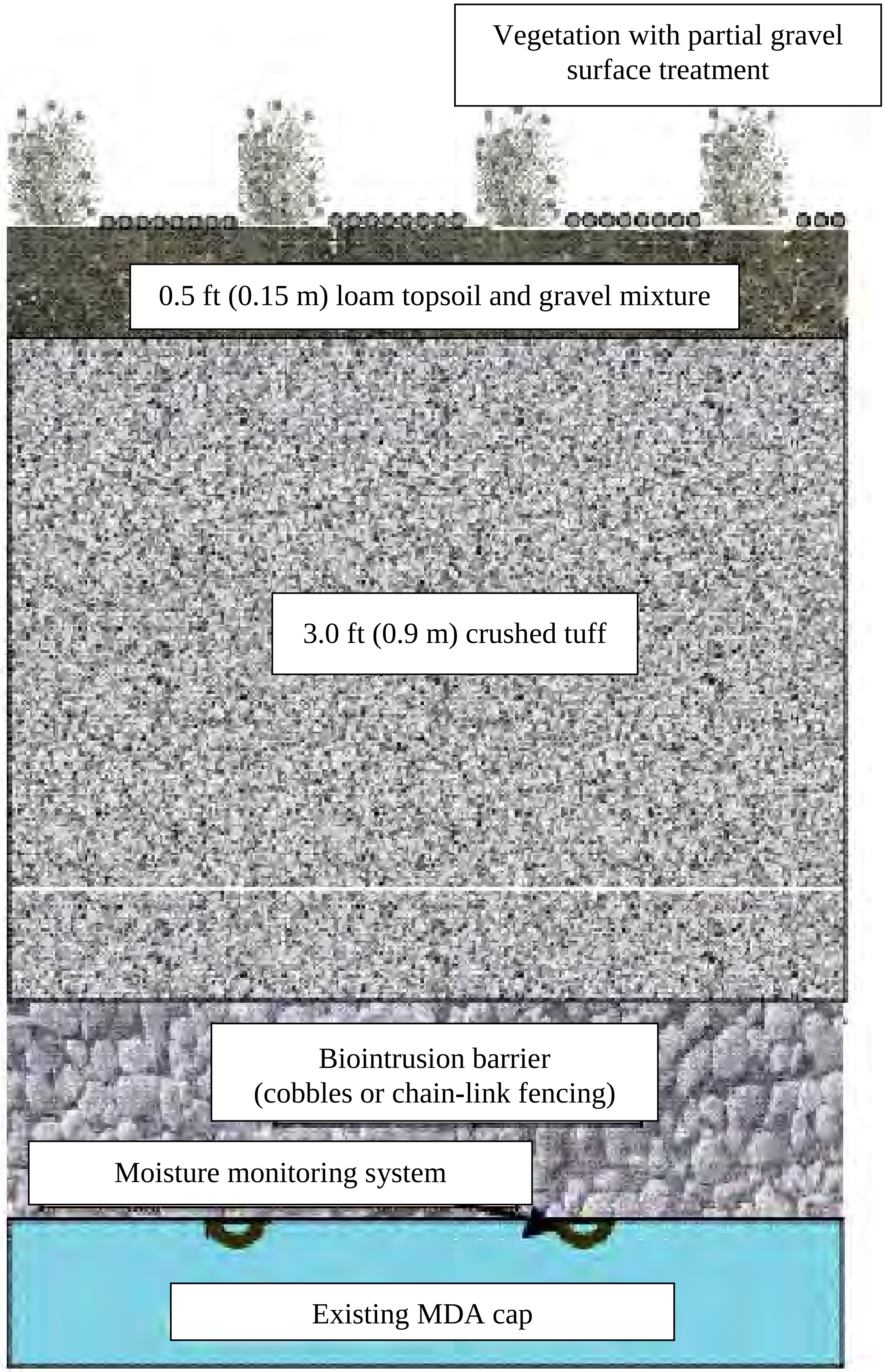

Figure 6. Engineered ET cover (drawing not to scale).

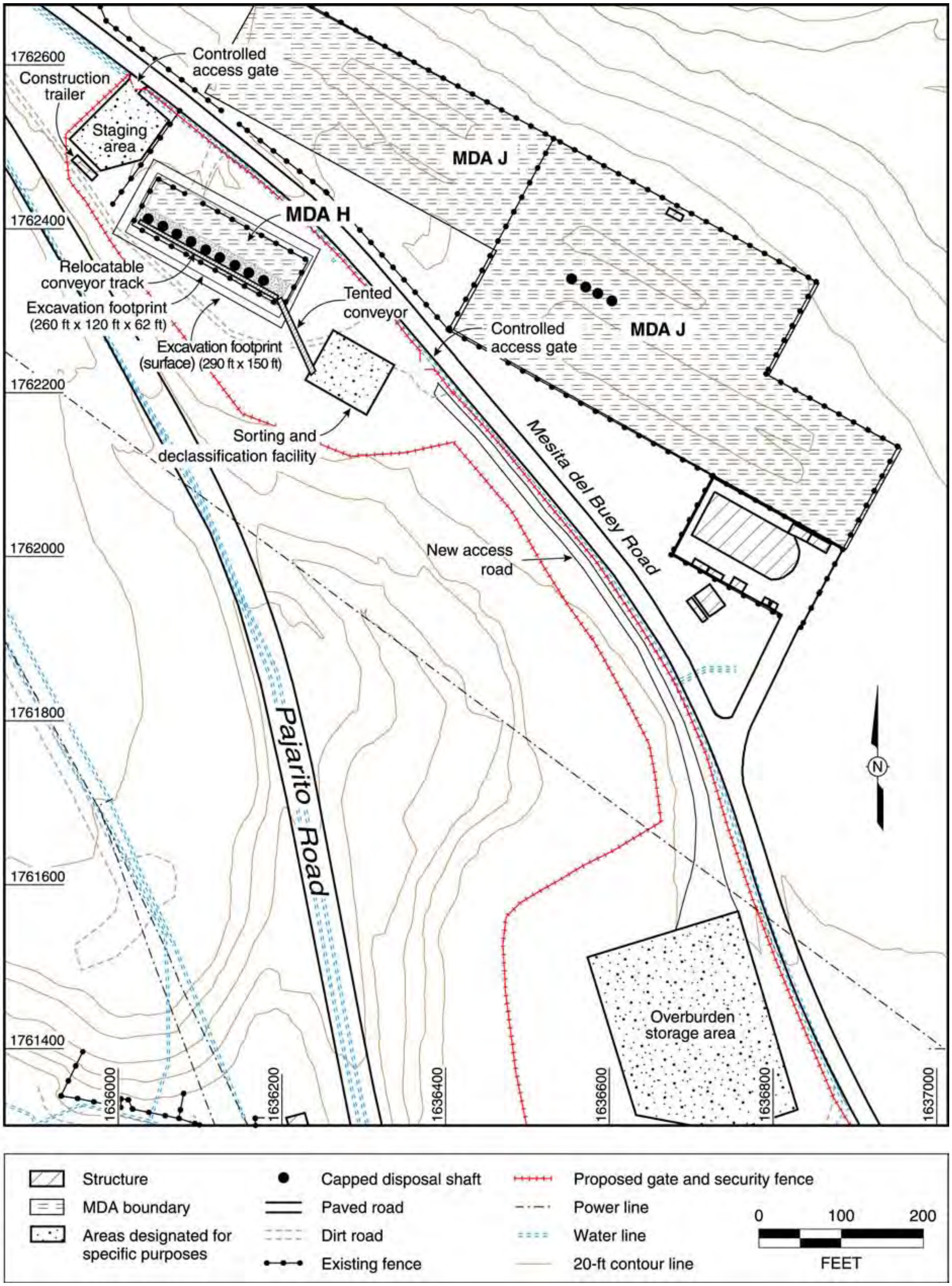

Figure 9. Conceptual design for structures and site changes to facilitate complete excavation and removal corrective measure Options 4 and 5.

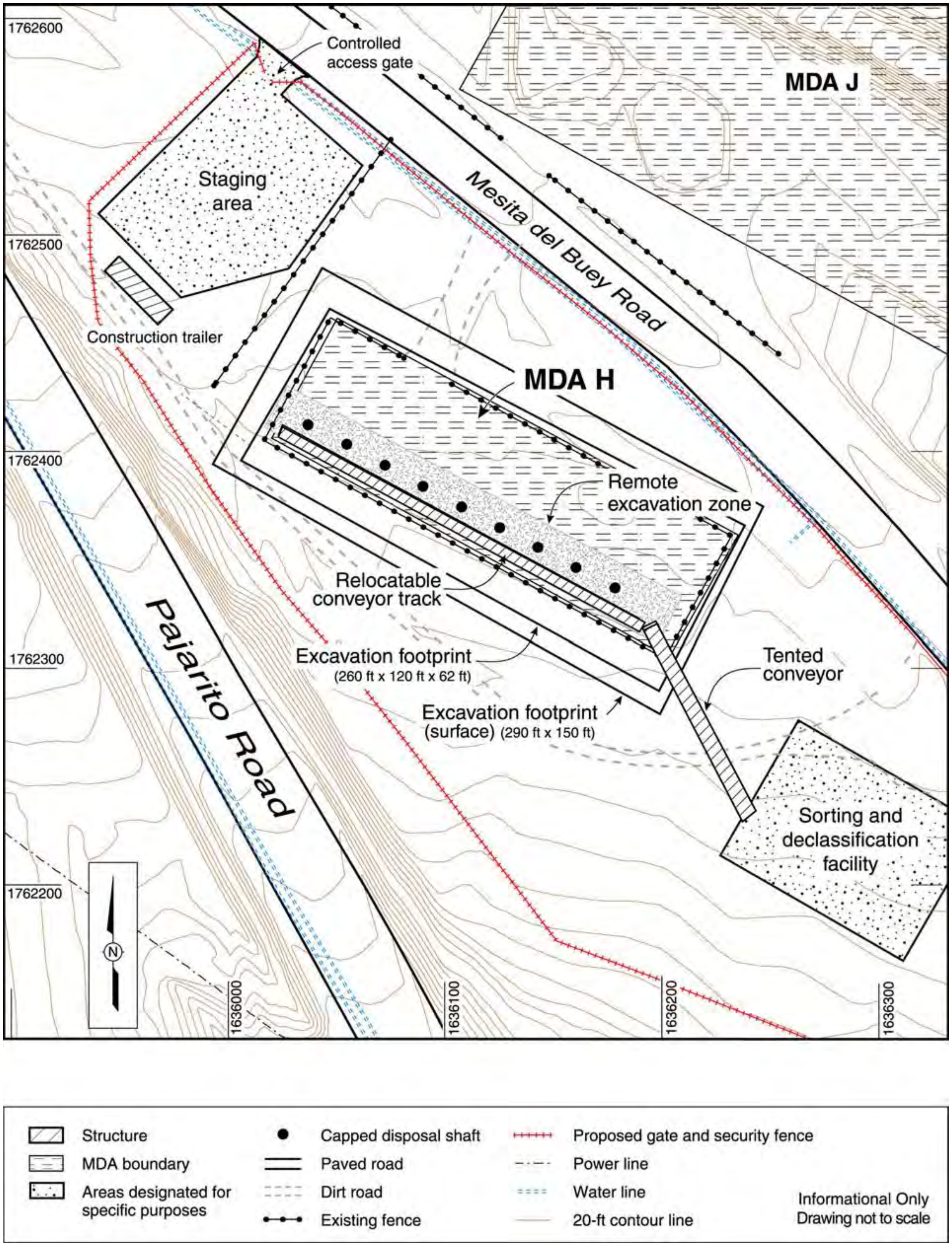

Figure 10. Close up view of MDA H conceptual site changes to facilitate complete excavation and removal corrective measure Options 4 and 5.

Corrective Measure Technology Category	Sub Category Technology	Candidate Technology	Description	Screening Comments
Containment	Vertical Barriers	Slurry Walls	A trench or series of boreholes around a disposal shaft to avoid island filled with cement-grout or other barrier material to impede lateral movement of contaminants	Potentially applicable
		Rock-Grout Mixing	Formed by drilling adjacent deep shafts around a disposal shaft, then mixing the cut rock with injected grout as the shaft is drilled to impede lateral movement of contaminants	Potentially applicable
		Synthetic Membrane	A membrane or liner placed in a vertical trench to form a wall to impede lateral movement of contaminants	Potentially applicable
	Deep-Subsurface Horizontal Barriers	Deep-Subsurface Horizontal Barriers	A horizontal layer placed beneath a disposal shaft to contain downward aqueous phase transport	Not applicable to site release and transport pathways
	Near-Surface Horizontal Barriers	Soil-Grout Mix	A layer of grout-stabilized soil overlying the existing concrete caps to enhance impermeability to water and impenetrability by plants and animals	Potentially applicable
		Vitrification	The formation of an impermeable, impenetrable layer of glass-like material by using electrical resistance to melt existing soil or rock	Potentially adverse to some waste types at the site
	Surface Barriers	Asphalt Cover	An asphalt layer placed to impede surface erosion	Asphalt traps moisture beneath cover which is not desirable
		Compacted Clay Cover	Designed to control excess infiltration into disposal units	Limited effectiveness in arid environments
		Multi-Layer Cover	Layers of geologic and synthetic materials placed to inhibit infiltration, erosion, and biotic intrusion	Disruption in the continuity of discreet layers can go undetected and compromise functionality
		Evapotranspiration Cover	A single thick layer of non-clayey soil which imbibes and holds moisture near the surface to be evaporated or transpired	Potentially applicable
		Biotic Barriers	Horizontal barriers of various geologic or manmade materials placed to control the intrusion of plants or animals	Potentially applicable

Technology or process option eliminated from further evaluation

Figure 12 (1). Screening of Corrective Measures Technologies.

Corrective Measure Technology Category	Sub Category Technology	Candidate Technology	Description	Screening Comments
In Situ Treatment	Biological Treatment Methods	Microorganisms	Microorganisms that feed on organic material have been effective in treating low-level concentrations of radioactive waste in wastewater treatment processes	Method has not been shown to be effective in treating variable waste types (paper, HE, metals, plastics, etc.)
	Physical Treatment Methods	Soil-Gas Venting	Open boreholes allow the release of subsurface vapors and gases to the atmosphere or to a treatment system	Potentially applicable for tritium plume reduction
		Soil Vapor Extraction	Use of air pressure, vacuum, or diffusion force to remove subsurface vapors or gases to a treatment system	Potentially applicable for tritium plume reduction
		Pneumatic Fracturing	Injection of pressurized fluid to create open fractures to allow access to contaminated media for removal or treatment	Introduces large volumes of water into a low-moisture system and may potentially detonate HE
		Electrokinetic Soil Treatment	In situ process that uses an electrical current for the continuous removal of ionic or charged species from soils including heavy metals, radionuclides, and select organic chemicals	Direct current may potentially detonate HE
		Electroaccoustic Treatment	In situ process that electroaccoustically decontaminates soils containing hazardous organic chemicals	Not applicable because the shafts contain very little soil
		Dynamic Compaction	Compaction used to compact and consolidate wastes in place to reduce subsidence	Subsidence of minor concern with shafts; may potentially detonate HE
		Waste Stabilization	Injection of grout around or mixing with waste, or heat-induced vitrification to solidify waste	Void space reduction does not improve site performance; wastes not amenable to pulverization; and use of heat may be adverse to some waste types at the site
		Thermal Treatment	Thermal treatment generated using microwave, radio frequency, or thermal radiation to decompose heat sensitive contaminants into less toxic or mobile forms, or to enhance extractability	Treatment type may be adverse to some waste types at the site

[shaded box] Technology or process option eliminated from further evaluation

Figure 12 (2). Screening of Corrective Measures Technologies.

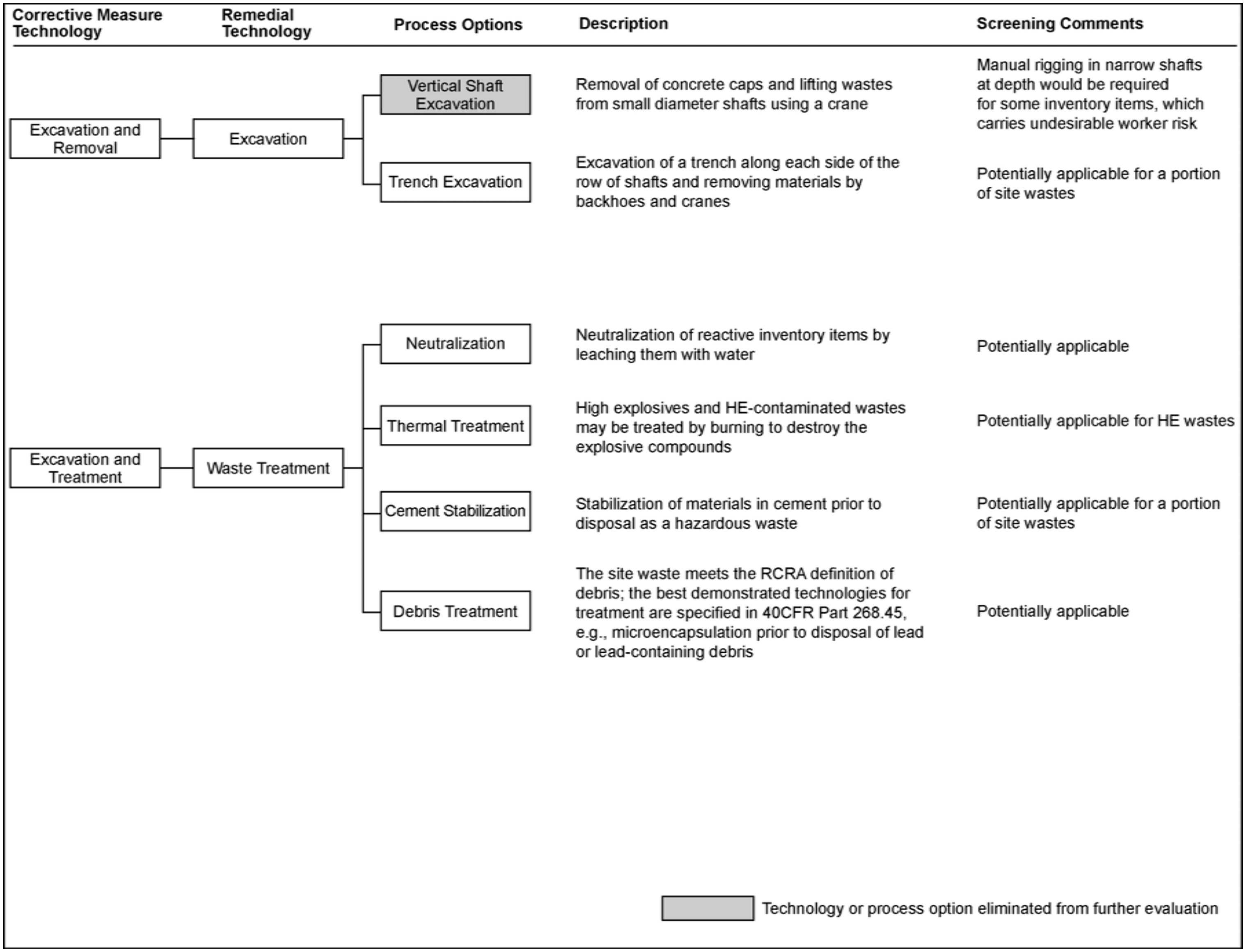

Figure 12 (3). Screening of Corrective Measures Technologies.